Eider ducks in Canada

edited by Austin Reed

Les eiders au Canada

dirigé par Austin Reed

Canadian Wildlife Service
Report Series Number 47

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Erratum

Les eiders au Canada / Eider ducks in Canada
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Page 47, tableau 4, le définition de $\hat{Y}$ qui apparaît dans la note devrait être:

$\hat{Y} = N\bar{y} \pm (tNs/\sqrt{n})\sqrt{1-f}$ où

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Environment Canada
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Environnement Canada
Service canadien de la faune

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Série de rapports nº 47

This publication consists of 18 separate papers. Twelve are presented in English and five in French. The final paper appears in both languages. Each paper has an abstract in the second official language, and those of special interest to Inuit (11 in all) also have an abstract in Inuktitut.

Cette publication comprend 18 articles différents. Douze sont présentés en anglais, cinq en français, et le dernier est bilingue. Chaque article possède un résumé dans la deuxième langue officielle. De plus, pour les articles intéressant particulièrement les Inuit (onze en tout), un résumé en inuktitut a été ajouté.

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Cover
Top: American Eider (*Somateria mollissima dresseri*), Ile aux Pommes, Quebec (photo: A. Reed)

Lower left: American Eider, Ile aux Pommes, Quebec (photo: A. Reed)

Lower centre: American Eider, Ile Bicquette, Quebec (photo: F. Bruemmer)

Lower right: St. Helena Island, NWT (photo: A. Dzubin)

Couverture :
En haut : Somateria mollissima dresseri, Ile aux Pommes, Québec (photo : A. Reed)

En bas, à gauche : Somateria mollissima dresseri, Ile aux Pommes, Québec (photo : A. Reed)

En bas, au centre : Somateria mollissima dresseri, Ile Bicquette, Québec (photo : F. Bruemmer)

En bas, à droite : Île Sainte-Helena, T.N.-O. (photo : A. Dzubin)

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Foreword

Eiders occupied a special place in the hearts of the creators of the Migratory Birds Convention of 1916 between the United States and Great Britain on behalf of Canada:

> Article IV — The High Contracting Parties agree that special protection shall be given the wood duck and the eider duck either (1) by a closed season extending over a period of at least five years, or (2) by the establishment of refuges, or (3) by such other regulations as may be deemed appropriate.

The reasons for that special concern were that the number of eiders along the Atlantic coast (and of Wood Ducks over most of their range) had become noticeably depleted since about 1880 and their extinction was feared.

One function of this report is to provide, implicitly rather than explicitly, an account of the success of nearly 70 years of "special protection." The story is a patchy one. In the Maritimes and the St. Lawrence estuary, the Common Eider is again common in those places that meet its needs. In the Arctic it is far more numerous, yet perhaps doing proportionately less well. Eiders decreased because they were overexploited. In some northern areas they still, or again, are.

Eiders still occupy a special place in the hearts of many Canadians. Canada, because of its large geographical extent, as well as the broad cultural diversity it harbours, forms an appropriate background for this attempt to display the knowledge that some people, for whom eiders are of special interest, have accumulated on the life history of this bird.

The unique possibility of non-destructive exploitation of eiders lies in the exceptional quality of their nest down as a light, highly compressible and highly efficient insulating material, still superior to any modern substitute in the making of winter clothing. A breeding colony of eiders farmed with the reverent care practised in Iceland, where they are everywhere treated as valuable property, can yield a considerable annual income from the taking of down. In Canada, the down industry has been largely limited to the St. Lawrence and has not been pursued in the cautious Icelandic way.

In Labrador, northern Quebec, and the eastern Arctic, the exploiters of eiders have been more interested in taking eggs than down and interested as well in shooting adults, often in large numbers in their wintering and breeding areas. Eiders are not well suited to hunting because they take 2–4 years to reach sexual maturity and because, in most years their breeding success, measured as young birds reaching flying age, is very low. Yet the great numbers of eiders wintering off the shore of Newfoundland, southern Labrador and in the Gulf of St. Lawrence have invited attack, mostly by people living in a subsistence economy, the rigours of eider-hunting not being as inviting to recreational hunters.

The successful management of eider stocks is thus a difficult matter. It is hard to find out how many there are and whether particular groups are holding their own, expanding, or declining. It is hard to find out who is killing which birds, where, and when. It is hard to devise appropriate regulations to limit their use to safe levels. And it is particularly hard to enforce regulations when most hunting is done by indigenous people, much of it outside the basic open season (1 September – 10 March) and in remote areas. The hazards are especially acute at present, when better weapons, boats, and engines have become available to people in transition from a subsistence economy to one based on the very different standards of the "southern welfare economy."

The reports which follow are thus presented as contributions to knowledge of a valuable resource, in the belief that better facts and understanding improve our chances of using eiders safely and, when necessary, of affording them additional protection in effective ways.

HUGH BOYD

Avant-propos

Les auteurs de la Convention concernant les oiseaux migrateurs, conclue en 1916 entre les États-Unis et la Grande-Bretagne au nom du Canada, se préoccupaient beaucoup du sort de l'eider. En effet, à l'Article IV, on peut y lire :

> « Les Hautes Puissances contractantes conviennent de donner une protection spéciale au Canard huppé et à l'Eider à duvet, soit (1) par un temps prohibé couvrant une période d'au moins cinq ans, ou (2) par l'établissement de refuges, ou (3) par tous les autres règlements que l'on pourra juger utiles.»

Les raisons de cette inquiétude étaient la diminution notable, depuis 1880 environ, du nombre des eiders vivant le long de la côte de l'Atlantique (et des Canards huppés dans presque toute leur aire de répartition), ainsi que la crainte d'une extinction de l'espèce.

L'un des buts de ce rapport est de rendre compte, d'une façon plus implicite qu'explicite, des succès obtenus en près de 70 ans de «protection spéciale». Succès inégaux, puisque dans les Maritimes et dans l'estuaire du Saint-Laurent, l'Eider à duvet prospère de nouveau dans les endroits correspondant à ses besoins, tandis que dans l'Arctique, où il est beaucoup plus abondant, sa situation semble s'être relativement dégradée. La surexploitation, qui avait fait fondre le nombre des eiders, est encore, ou de nouveau, la règle dans certaines régions nordiques.

Beaucoup de Canadiens sont encore attachés à l'eider. Le Canada, en raison de sa vaste étendue géographique et de sa grande diversité culturelle, est un théâtre choisi pour diffuser les connaissances que certaines personnes particulièrement intéressées à l'eider ont accumulées sur la vie de cet oiseau.

La seule possibilité d'exploitation non destructive de l'eider réside dans la qualité exceptionnelle de son duvet, un isolant léger, très compressible et très efficace, encore supérieur à tout substitut moderne pour la fabrication des vêtements d'hiver. Une colonie d'eiders reproducteurs élevés avec les soins attentifs qu'on leur prodigue en Islande, où ils sont toujours traités comme un bien précieux, peut rapporter un revenu annuel considérable grâce à la cueillette du duvet. Au Canada, cette activité est largement limitée au golfe et à l'estuaire du Saint-Laurent, et n'est pas effectuée avec la même prudence qu'en Islande.

Au Labrador, dans le nord du Québec et dans l'est de l'Arctique, ceux qui exploitent l'eider sont davantage intéressés à prendre les oeufs que le duvet et à chasser les adultes, souvent en grandes quantités, dans leurs aires d'hivernage et de nidification. Les eiders se prêtent mal à l'exploitation par la chasse parce qu'il leur faut de deux à quatre ans pour atteindre la maturité sexuelle et que la plupart des années, leur taux de reproduction, calculé d'après le nombre de juvéniles atteignant l'âge de voler, est très bas. Pourtant, l'abondance des eiders hivernant sur les côtes de Terre-Neuve, du sud du Labrador et du golfe du Saint-Laurent en a fait une cible de choix, surtout pour les chasseurs de subsistance, les rigueurs de la chasse à l'eider rebutant les chasseurs sportifs.

La gestion des populations d'eider est donc une tâche ardue. Il est difficile d'évaluer leur nombre et de découvrir si des groupes particuliers se maintiennent, prospèrent ou déclinent. Il est malaisé de savoir quels oiseaux sont tués, par qui, à quel endroit et à quel moment. La mise au point de règlements adéquats, pour en limiter l'exploitation à un niveau raisonnable, est un travail délicat, et l'application des règlements s'avère encore plus difficile quand la plus grande partie de la chasse est faite par des autochtones, largement en dehors de la saison de chasse ordinaire (1er septembre au 10 mars) et dans des régions éloignées. La menace qui pèse sur l'espèce est particulièrement grave aujourd'hui, où des armes, des embarcations et des moteurs plus efficaces sont à la disposition de populations effectuant la transition entre une économie de subsistance et une économie de bien-être très différente, à l'image de celle du Sud.

Les rapports suivants sont donc présentés comme des contributions à la connaissance d'une ressource de valeur, dans l'espoir qu'une meilleure information et une meilleure compréhension amélioreront nos chances de l'utiliser raisonnablement ou bien, si nécessaire, d'offrir à l'eider une plus grande protection.

HUGH BOYD

Part I
Distribution and abundance

Section I
Distribution et abondance

(photo: A. Reed)

Distribution, abondance et fluctuation des populations d'Eider à duvet dans l'estuaire et le golfe du Saint-Laurent

Distribution, abundance, and fluctuation of eider populations in the St. Lawrence estuary and gulf

G. Chapdelaine
P. Dupuis
A. Reed

1. Résumé

D'après les inventaires effectués principalement entre 1972 et 1982, nous évaluons la population actuelle d'Eider à duvet à environ 18 500 couples reproducteurs dans l'estuaire du Saint-Laurent et à 5500 dans le golfe. Dans l'estuaire, 88 % de la population se concentre sur seulement cinq îles (l'île Bicquette, l'île aux Fraises, l'île Blanche, l'île aux Pommes et les îles du Pot à l'Eau-de-Vie) avec des densités dépassant 400 nids/ha. Dans le golfe, la population est dispersée dans un vaste territoire ne formant que de petites colonies dont la densité ne dépasse pas 3 nids/ha. La population de l'estuaire est en bonne condition malgré des menaces potentielles telles que l'intensification du trafic maritime et le dérangement des oiseaux par les humains. En contrepartie, la population du golfe a diminué considérablement au cours des trois dernières décennies, cette situation étant attribuable au braconnage. Un contrôle sévère de cette activité illégale ainsi que la mise en oeuvre d'un programme de sensibilisation du public sont nécessaires au rétablissement de cette population.

2. Abstract

Various surveys conducted mainly between 1972 and 1982 indicate breeding populations of about 18 500 pairs of Common Eiders in the St. Lawrence estuary and 5500 in the gulf. In the estuary, 88% of the population is found on five islands (Ile Bicquette, Ile aux Fraises, Ile Blanche, Ile aux Pommes, and Iles du Pot à l'Eau-de-Vie) where it forms dense colonies exceeding 400 nests/ha. In the gulf, the population is widely dispersed over a vast area, forming only small colonies with densities of less than three nests/ha. The estuary population is considered to be flourishing despite the potential threats of heavy marine traffic and human disturbance. In the gulf, however, the population has undergone a severe decline over the past three decades due to poaching. Intensive law enforcement and a public awareness program are essential to the recovery of this population.

3. Introduction

L'Eider à duvet (*Somateria mollissima dresseri*) niche dans plusieurs îles de l'estuaire et du golfe du Saint-Laurent. Reed (1975) a déjà estimé la population d'eider de l'estuaire à environ 20 000 couples. Pour le golfe, aucune estimation n'a été effectuée, mais il existe des informations partielles provenant des inventaires quinquennaux des refuges d'oiseaux marins de la Côte-Nord effectués entre 1925 et 1982 (Lewis, 1925, 1931, 1937, 1942; Hewitt, 1950; Tener, 1951; Lemieux, 1956; Moisan, 1962; Moisan et Fyfe, 1967; Nettleship, 1973; Chapdelaine, 1980; Chapdelaine et Brousseau, 1984).

Le but du présent travail est de mettre à jour la distribution et l'abondance de l'Eider à duvet dans l'estuaire et le secteur québécois du golfe du Saint-Laurent. Erskine et Smith (présente publication) décrivent les populations des autres secteurs du golfe. Nous avons rassemblé tous les relevés d'inventaire non publiés du Service canadien de la faune (SCF) de la Région du Québec afin d'extraire les paramètres nécessaires à l'estimation des populations. Nous avons aussi recueilli des données historiques afin de connaître l'évolution des populations.

Dans le présent article, nous considérons les populations de l'estuaire et du golfe du Saint-Laurent comme deux entités distinctes parce que ces deux populations sont séparées par plusieurs centaines de kilomètres et que du point de vue de la conservation, leur situation est différente.

La population d'Eider à duvet de l'estuaire se répartit dans quelques îles. Les principales activités de la population humaine occupant les deux rives du secteur sont l'agriculture, l'industrie du bois et le tourisme. Bien que le braconnage soit presque absent, la navigation de plaisance s'intensifie dès l'arrivée des eiders au printemps. Les concentrations spectaculaires de cette espèce attirent les touristes, les naturalistes, les biologistes et les cueilleurs de duvet. Malgré les bonnes intentions de ces gens, le dérangement dû à leurs déplacements s'avère préjudiciable aux populations d'Eider à duvet.

La population d'Eider à duvet de la côte nord du golfe du Saint-Laurent est moins abondante et se répartit dans un très grand nombre d'îles situées sur plus de 600 km de côte. La population humaine est également restreinte à plusieurs petits villages qui, à l'est de Havre-Saint-Pierre, ne sont pas encore reliés par un réseau routier. Économiquement défavorisée, la population pratique surtout la pêche, très souvent selon un mode artisanal familial. En conséquence, il existe un trafic relativement intense de petites embarcations dont certains occupants pratiquent encore la chasse printanière et le ramassage d'oeufs d'eider, en dépit de la présence d'agents de conservation de la faune. En raison de la faible densité des nids, la cueillette du duvet est presque inexistante. Nous prévoyons que le tourisme s'intensifiera avec l'établissement prochain d'un parc national dans l'archipel de Mingan et le prolongement éventuel du réseau routier au-delà de Havre-Saint-Pierre.

4. Méthode

4.1. Estuaire du Saint-Laurent □

Reed (1975) a déjà présenté de façon détaillée les méthodes d'inventaire utilisées pour évaluer les populations d'Eider à duvet des îles de l'estuaire du Saint-Laurent. Ces méthodes se résument ainsi :
Virées continues — Un certain nombre de lignes traversent l'île inventoriée. Ces lignes ont une largeur de 3 m et tous les nids sont dénombrés à l'intérieur de cette étendue. En relevant la longueur de ces lignes, nous pouvons calculer la superficie inventoriée et obtenir une densité de nids (nids/m^2) extrapolée à la superficie totale de l'île occupée par la colonie. Cette méthode d'estimation a été appliquée à l'île

Bicquette, l'île Blanche, l'île aux Fraises et les îles du Pot à l'Eau-de-Vie.

Unités d'échantillonnage de tailles différentes — Cette méthode est appliquée uniquement à l'île aux Pommes. L'île est divisée en 54 transversales dont la superficie varie entre 354 et 3746 m². Nous avons sélectionné 11 transversales sur une possibilité de 40 pour la strate moyennement dense (28,1 % de la superficie totale de la strate) et 4 sur 14 pour la strate dense (27,5 %). La densité spécifique de chacune des strates est extrapolée à leur superficie respective pour obtenir l'estimation de chacune d'elles.

Dénombrements systématiques — Il s'agit de dénombrer tous les nids sur l'île à une date correspondant à la période de présence maximum des nids. Les petites îles se prêtent très bien à ce type d'inventaire.

Estimation visuelle — Pour quelques îles, où les effectifs et la densité des nids étaient faibles, nous avons établi une estimation en se basant sur le nombre d'adultes observés à proximité de l'île.

4.2. Golfe du Saint-Laurent □

À cause du très grand nombre d'îles le long de la côte nord du golfe du Saint-Laurent et de la distribution très éparse des nids d'eider, nous avons dû utiliser une méthode d'extrapolation pour obtenir une estimation très approximative. Pour ce faire, nous avons divisé les quelque 600 km de côte en cinq zones (figure 1). Les îles de chacune de ces zones ont une certaine homogénéité quant à leur physionomie. Nous avons estimé la population de chacune des zones en multipliant les densités respectives (nids/ha) par la superficie totale des îles comprises dans chaque zone. Les densités respectives ont été calculées d'après des inventaires effectués au sol entre 1977 et 1982. Les résultats détaillés de ces inventaires sont consignés dans Chapdelaine (1977, 1978), Chapdelaine et Bourget (1981) et Brousseau et Chapdelaine (1983).

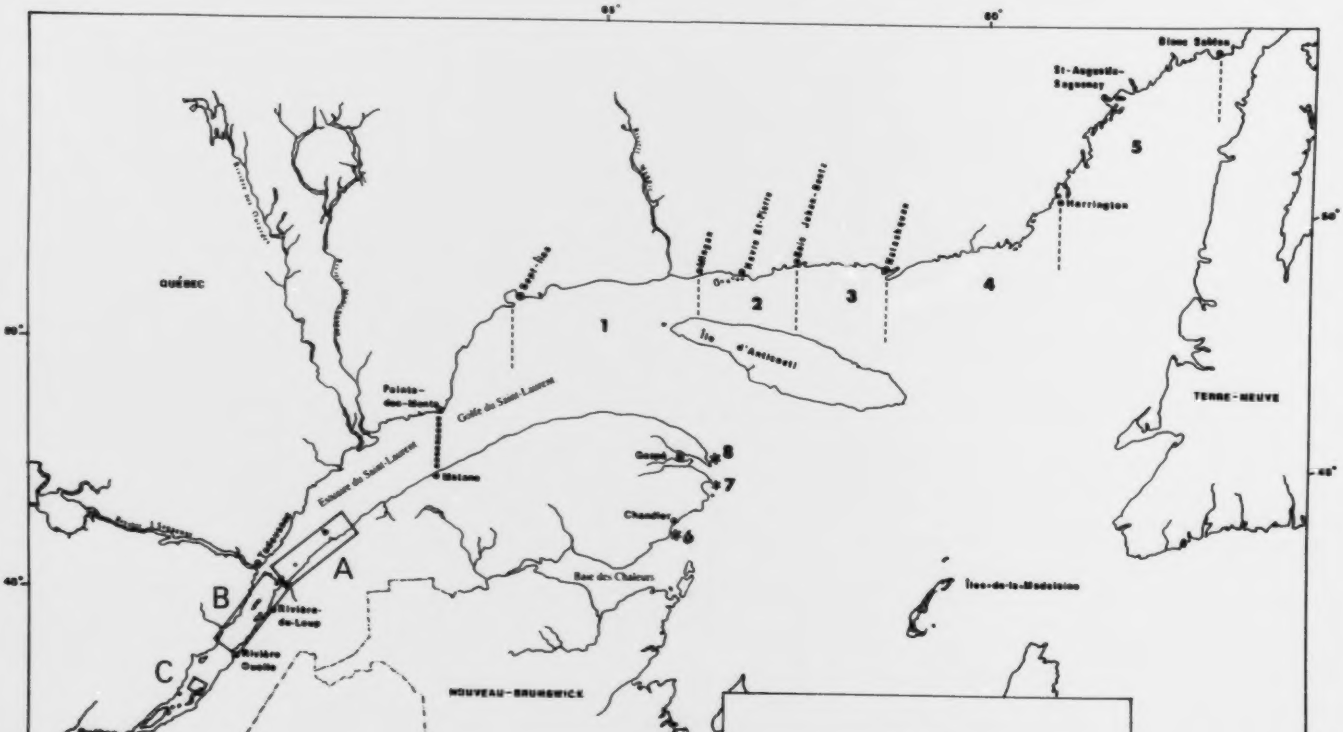
Quant aux côtes de la péninsule gaspésienne où il y a très peu d'îles, nous avons réalisé, en 1979, des inventaires systématiques dans les quelques sites où niche l'espèce. Aux Îles-de-la-Madeleine, Aubry (1982) a récemment confirmé la nidification de cette espèce par l'observation de crèches autour des îles. À l'aide de ces informations, nous avons estimé le nombre de nids qu'il pourrait y avoir dans ce secteur.

4.3. Valeur des estimations □

La situation géographique des îles, le type de végétation, la densité des nids et le temps disponible aux recenseurs sont les facteurs qui nous ont incités à utiliser différentes méthodes. La précision des estimations est donc variable d'une île à l'autre et parfois impossible à quantifier. Afin de permettre aux lecteurs de juger de la valeur de nos estimations, nous avons indiqué les méthodes utilisées pour les îles recensées au tableau 1.

Les estimations obtenues d'après les dénombrements systématiques sont les plus précises. L'estimation pour l'île aux

Figure 1
Le golfe et l'estuaire du Saint-Laurent indiquant les zones de nidification de l'Eider à duvet (A à C, estuaire; 1 à 5, côte nord du golfe; 6 à 8, Gaspésie)
The gulf and estuary of the St. Lawrence showing Common Eider nesting zones (A–C, estuary: 1–5, north shore of gulf; 6–8, Gaspé Peninsula)


65°
60°
50°
48°
Blanc Sablon
St-Augustin-Saguenay
5
Harrington
QUÉBEC
Sept-Îles
Mingan
Havre St-Pierre
Baie Johan-Beetz
Natashquan
1
2
3
4
Île d'Anticosti
Pointe-des-Monts
Golfe du Saint-Laurent
TERRE-NEUVE
Estuaire du Saint-Laurent
Matane
Gaspé
8
7
Chandler
6
Tadoussac
A
B
Rivière-du-Loup
Baie des Chaleurs
Îles-de-la-Madeleine
C
Rivière Ouelle
NOUVEAU-BRUNSWICK
Québec
km

Pommes, d'après les unités d'échantillonnage de tailles différentes, est assez juste avec un pourcentage d'erreur de ± 22 % (limites de confiance à 95 %). Quant aux estimations obtenues selon les virées continues, nous avons calculé des pourcentages d'erreur de ± 44 % (limites de confiance à 95 %) pour l'île Blanche, ± 28 % pour l'île aux Fraises, ± 12 % pour l'île Bicquette et ± 15 % pour les îles du Pot à l'Eau-de-Vie. La méthode d'extrapolation utilisée pour estimer la population de la côte nord du golfe du Saint-Laurent ne nous permet pas d'établir les intervalles de confiance sur l'estimation.

5. Résultats

5.1. Estuaire du Saint-Laurent

Au tableau 1, nous présentons les plus récentes estimations des populations d'Eider à duvet dans l'estuaire du Saint-Laurent. Nous estimons la population totale à près de 18 452 couples. Cette estimation est approximative à cause de l'absence de concomitance entre les années d'inventaire de chacune des îles et les erreurs inhérentes aux méthodes d'inventaire.

Près de 88 % de la population de l'estuaire se concentre dans cinq îles ou groupes d'îles qui, par ordre d'importance, sont : l'île Bicquette, l'île aux Fraises, l'île Blanche, l'île aux Pommes et les îles du Pot à l'Eau-de-Vie (figure 2). C'est aussi sur ces îles qu'en 1976, nous retrouvons les plus fortes densités atteignant, par exemple, à l'île Bicquette, 741,5 nids/ha.

Reed (1975) a déjà relaté l'historique de la population d'Eider à duvet de l'estuaire entre 1935 et 1972. Il estime qu'elle est passée de quelques douzaines de couples à environ 20 000 couples. À cause de l'absence d'inventaires réguliers sur toutes les îles, il nous est difficile de connaître l'évolution réelle de la population totale depuis 1972. Néanmoins, nous avons présenté à la figure 3 une série d'histogrammes qui montrent l'évolution des populations d'Eider à duvet dans cinq îles où la fréquence des inventaires a été égale ou supérieure à trois entre 1963 et 1978. Nous constatons qu'à l'île aux Pommes, la population s'est maintenue à un niveau élevé entre 1965 et 1970, soit une moyenne de 2778 nids. En 1971, l'inventaire révélait une baisse; la population oscillait autour d'une moyenne de 1700 nids entre 1971 et 1978, soit une diminution de 38 % par rapport à la période précédente. Le dernier inventaire effectué à l'île Blanche en 1976 a révélé le plus bas niveau par rapport aux estimations obtenues avant cette date, ce qui représente une diminution de 27 % par rapport aux effectifs de 1972. À l'île aux Fraises, nous observons une tendance à la hausse entre 1967 et 1976 de l'ordre de 51 %. Enfin, aux îles Rasade Nord-Est et Sud-Ouest, la population a connu une augmentation importante entre 1964 et 1969 passant de 375 nids à 806 nids. À partir de 1970, cette population se maintenait à une moyenne de 614 nids sans manifester de tendances évidentes.

Les fluctuations dans ces cinq îles, qui accueillent 47 % de la population totale, suggèrent une légère diminution des effectifs de l'estuaire durant les années 1970. Compte tenu des augmentations substantielles dans les décennies antérieures, cette population semble toujours en bon état.

Figure 2
Les îles de l'estuaire du Saint-Laurent. Les cartes A à C correspondent aux zones identifiées par les mêmes lettres à la figure 1
The islands of the St. Lawrence estuary. The maps A–C correspond to the zones identified by the same letters in Figure 1

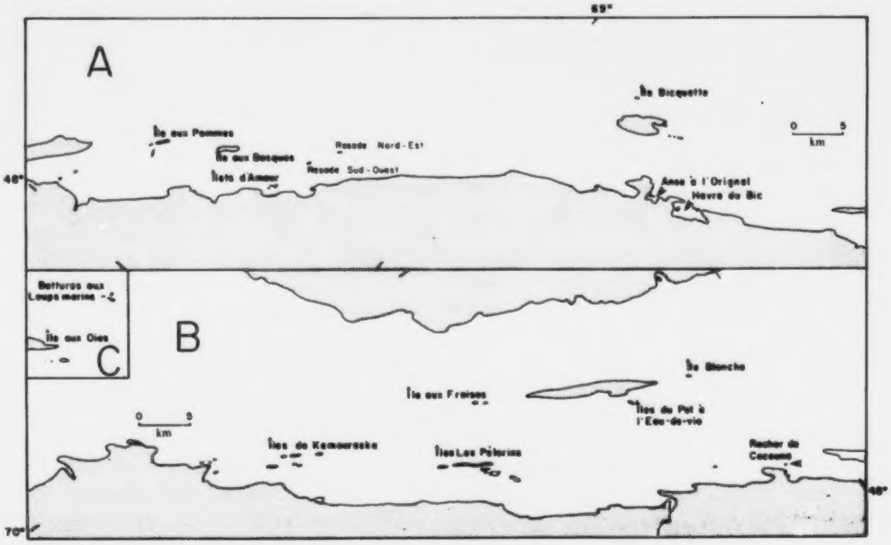


Tableau 1
Estimation du nombre de nids d'Eider à duvet dans les îles de l'estuaire du Saint-Laurent (voir figure 2 pour la localisation des îles)
Estimated number of Common Eider nests on the islands of the St. Lawrence estuary (see Figure 2 for island location)

Colonie *Colony*	Nombre de nids *Number of nests*	Année du dernier inventaire *Year of most recent survey*	Type d'inventaire *Survey method*
Île Bicquette et récifs	6 971	1976	v.c.*
Îlets du Havre du Bic et de l'Anse à l'Orignal	150	1971	e.v.†
Île Rasade Nord-Est	357	1977	d.s.‡
Île Rasade Sud-Ouest	345	1977	d.s.
Îlets d'Amour	59	1969	d.s.
Île aux Basques	69	1978	d.s.
Île aux Pommes	1 901	1978	u.e.§
Rocher de Cacouna	10	1971	e.v.
Îlet aux Alouettes	150	1968	e.v.
Île Blanche	2 856	1976	v.c.
Îles du Pot à l'Eau-de-Vie	1 250	1972	v.c.
Île aux Fraises	3 272	1976	v.c.
Îles Les Pèlerins	443	1974	d.s.
Îles de Kamouraska	584	1974	d.s.
Battures aux Loups Marins	35	1979	d.s.
Total	18 452		

*Virées continues.	**Transects.*
†Estimation visuelle.	†*Visual estimate.*
‡Dénombrement systématique.	‡*Total count.*
§Unité d'échantillonnage.	§*Sample plot.*

5.2. Golfe du Saint-Laurent □

Nous estimons la population d'Eider à duvet dans le golfe du Saint-Laurent à 5384 couples (tableau 2). Comparativement à l'estuaire, nous n'y trouvons pas de colonies aussi denses. La plupart du temps, les femelles nichent isolément. La plus importante colonie connue se trouve sur l'île des Loups [(50°10'N, 60°17'O) (zone 4)] avec 122 nids dénombrés systématiquement en 1977; à cet endroit, la densité y est de trois nids/ha seulement. Partout ailleurs sur la Côte-Nord, les inventaires révèlent des densités égales ou inférieures à cette valeur (Chapdelaine, 1978).

Figure 3
Évolution numérique des populations nicheuses d'Eider à duvet sur cinq îles de l'estuaire du Saint-Laurent, de 1963 à 1978
Changes in numbers of breeding Common Eiders on five islands in the St. Lawrence estuary, 1963–78

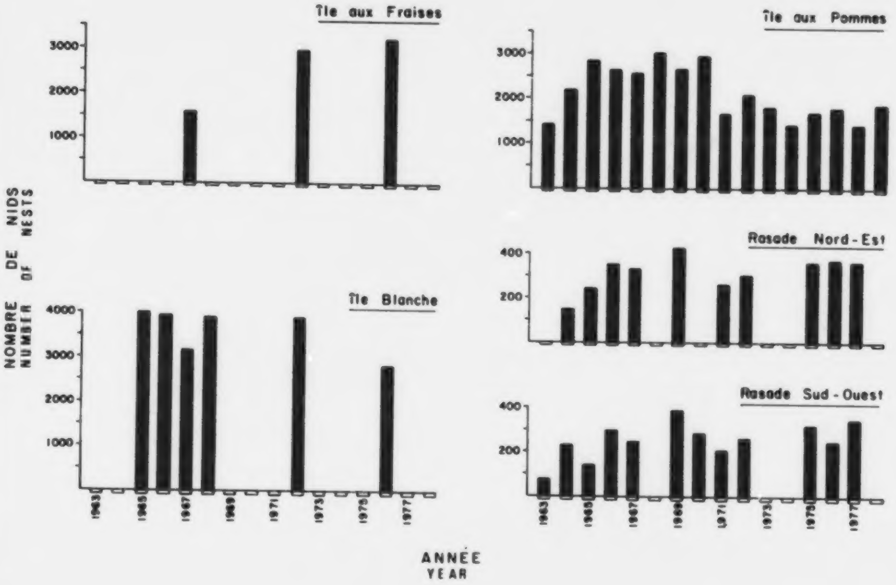


Tableau 2
Estimation du nombre de nids d'Eider à duvet dans le golfe du Saint-Laurent (voir figure 1 pour la localisation des régions)
Estimated number of Common Eider nests in the Gulf of St. Lawrence (see Figure 1 for location of zones)

Zones	Nombre de nids *Number of nests*	Dernière année d'inventaire *Year of most recent survey*	Type d'inventaire *Survey method*
Côte-Nord			
Sept-Îles à Longue Pointe de Mingan	150	1982	ex.*
Archipel de Mingan	114	1979	ex.
Baie Johan-Beetz à Natashquan	278	1982	ex.
Natashquan à Harrington	4290	1982	ex.
Harrington à Blanc Sablon	441	1977	ex.
Gaspésie			
Îlots Mahys	1	1979	d.s.†
Île Plate	35	1979	d.s.
Péninsule de Forillon	10	1979	d.s.
Îles-de-la-Madeleine	65	1982	e.v.‡
Total	5384		

*Extrapolation.
†Dénombrement systématique.
‡Estimation visuelle.

**Extrapolation.*
†Total count.
‡Visual estimate.

Les inventaires quinquennaux réalisés à l'intérieur des refuges permettent d'esquisser l'évolution de la population d'Eider à duvet sur la Côte-Nord. À la figure 4, nous avons illustré à l'aide d'histogrammes, l'évolution des populations dans sept refuges. Nous remarquons que les populations d'eider des refuges de Betchouane, Watshishu, île à la Brume et des îles Sainte-Marie se situent actuellement à leur plus bas niveau depuis 1925. La tendance à la baisse se manifeste drastiquement depuis 1965. Quant aux refuges de Baie-des-Loups et de Saint-Augustin, où les effectifs sont plus élevés, les niveaux sont bien inférieurs aux pics d'abondance obtenus entre 1940 et 1960. Seule la population de l'île du Corossol ne manifeste pas de diminution importante. À la lumière de ces résultats, nous devons reconnaître que la population d'Eider à duvet de la Côte-Nord a diminué substantiellement depuis 1965.

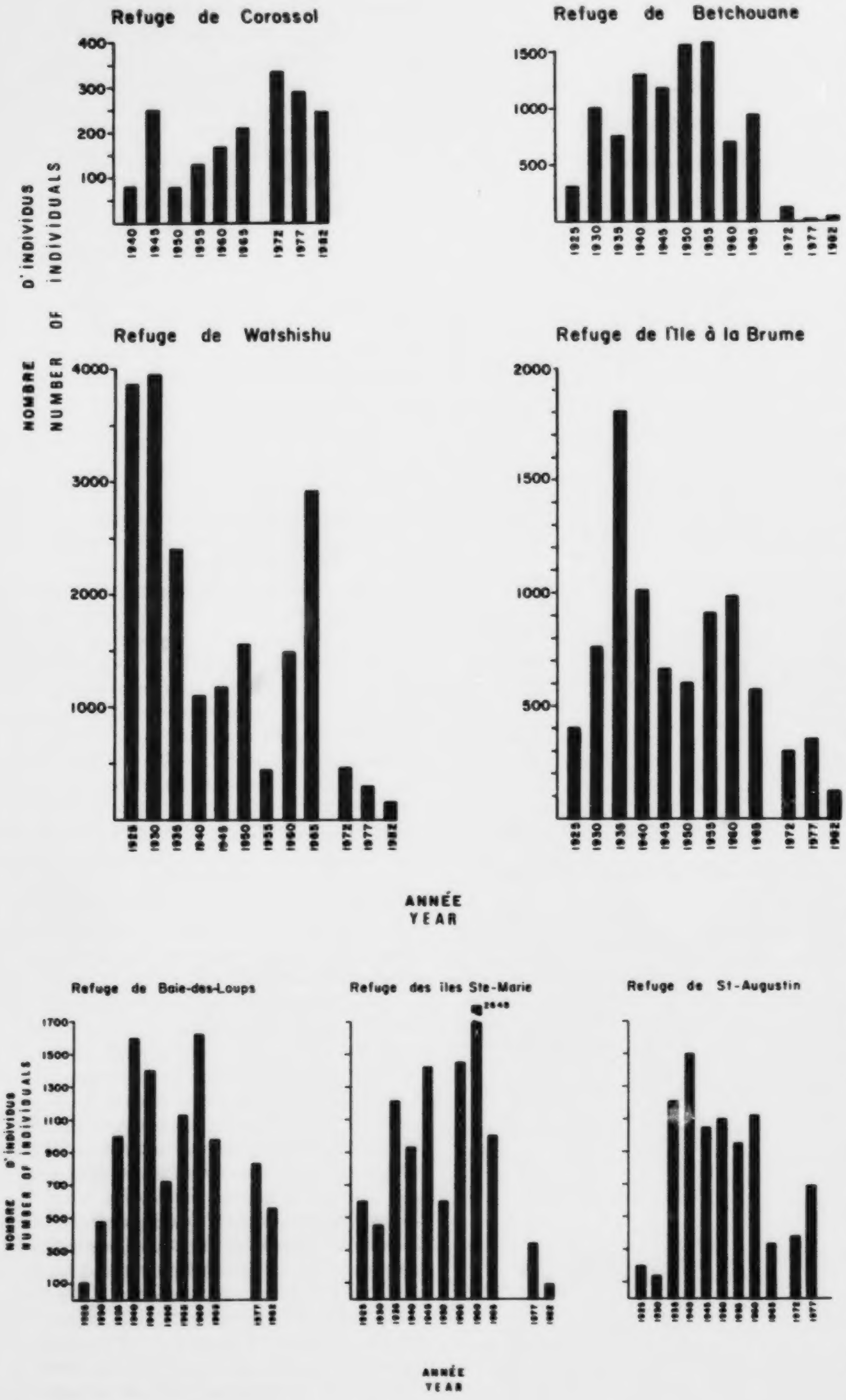
6. Analyse et conclusion

6.1. Estuaire du Saint-Laurent □

La légère diminution des effectifs qui semble s'être produite dans l'estuaire du Saint-Laurent pendant les années 1970 provient surtout de l'île aux Pommes et de l'île Blanche. Selon nos observations, cette diminution serait attribuable à des modifications de la couverture végétale et aux fréquences des visites des cueilleurs de duvet, des naturalistes et des biologistes qui étudient non seulement l'Eider à duvet, mais d'autres espèces d'oiseaux occupant ces îles. Les dérangements causés par ces visites ont pour effet d'augmenter la prédation des goélands (*Larus argentatus* et *L. marinus*) sur les oeufs et les canetons. Toutefois, à cause de la carence d'études d'impact sur ces populations, nous ne pouvons pas déterminer dans quelle proportion ces facteurs ont pu jouer un rôle.

La population d'Eider à duvet de l'estuaire du Saint-Laurent représente probablement la plus importante concentration de cette espèce en Amérique du Nord. D'un point de vue de conservation, la situation dans son ensemble peut sembler rassurante étant donné l'abondance de l'espèce, mais une telle concentration dans une aire géographique aussi particulière nous incite à être prudent. L'estuaire du Saint-Laurent représente une des voies maritimes les plus importantes et les plus utilisées en Amérique du Nord; en conséquence, les probabilités d'un désastre pétrolier y sont proportionnelles. Advenant un tel événement au moment de la saison de reproduction, on comprendra que l'avenir de la population d'Eider à duvet dépendra de la vulnérabilité de seulement cinq îles où se

Figure 4
Évolution numérique des populations nicheuses d'Eider à duvet dans sept refuges du golfe du Saint-Laurent, de 1925 à 1982
Changes in numbers of breeding Common Eiders at seven sanctuaries in the Gulf of St. Lawrence, 1925–82



concentre 88 % de la population de l'estuaire. Une distribution limitée des eiders facilite le travail d'inventaire et permet la rentabilité de l'exploitation du duvet sur une base commerciale mais nécessite, d'autre part, des mesures de conservation adéquates, telles que l'établissement de refuges ou de réserves. Actuellement, aucune des cinq îles abritant la presque totalité de la population ne possède le statut de réserve ou de refuge. Seules, l'île aux Basques, l'île Rasade Sud-Ouest et l'île Rasade Nord-Est sont des refuges aux termes de la Loi sur la Convention concernant les oiseaux migrateurs.

6.2. Golfe du Saint-Laurent □

L'importante diminution observée dans les refuges de la Côte-Nord est principalement due au braconnage (cueillette d'oeufs, chasse printanière et poursuite des couvées en été). Cette affirmation, quoique non confirmée statistiquement, est le fait de multiples observations et de réflexions de toute une génération de biologistes ayant oeuvré dans le secteur. Traditionnellement, les gens pratiquaient l'exploitation de l'Eider à duvet au début du siècle. La création des refuges et la mise en vigueur des lois de protection ont ralenti cette exploitation vers les années 1920 et ont permis un accroissement de la population. Mais, vers 1950, l'acquisition d'embarcations motorisées par un bon nombre de résidants locaux, et une attitude sociale encore imprégnée d'une tradition de chasse, contribuaient à une recrudescence du braconnage qui a atteint son paroxysme durant les années 1970 (Cairns, 1978; Blanchard, 1984). Toutefois, les efforts de gardiennage des agents du Ministère du Loisir, de la Chasse et de la Pêche du Québec (MLCP), de la Gendarmerie Royale du Canada, du SCF et le programme d'éducation de la «Fondation Québec–Labrador» auront permis de réduire le braconnage durant les cinq dernières années. Suite à cet effort, la situation de l'Eider à duvet s'est stabilisée et d'autres espèces d'oiseaux marins ont augmenté (Chapdelaine et Brousseau, 1984).

La distribution éparse et la grande dispersion des colonies sur la côte nord du golfe du Saint-Laurent offrent une certaine protection contre les activités humaines (trafic maritime, déversements de produits pétroliers, tourisme, braconnage). De sérieux préjudices peuvent être causés localement, mais un impact impliquant tout le territoire de la Côte-Nord apparaît invraisemblable, compte tenu de l'immensité du secteur. En intensifiant des efforts de sensibilisation du public et de l'application de la loi, cette population aurait, de toute évidence, un avenir florissant.

Eider à duvet femelle sur son nid, île Bicquette
Female Common Eider on nest, Ile Bicquette
(photo: F. Bruemmer)

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La distribution de l'Eider à duvet durant l'élevage des canetons dans l'estuaire du Saint-Laurent

The distribution of Common Eiders during the brood-rearing period in the St. Lawrence estuary

J. Bédard
J. Gauthier
J. Munro

1. Résumé

Des inventaires effectués régulièrement entre avril et octobre 1972 et 1973 ont permis de décrire la distribution de l'Eider à duvet (*Somateria mollissima*) le long des rives et sur le pourtour des îles de l'estuaire maritime du Saint-Laurent. Les densités moyennes (nombre moyen de mâles, de femelles et de canetons par kilomètre de rivage) pour l'ensemble de la saison estivale indiquent un déplacement de la population vers l'aval tôt après la fin de la reproduction. La densité moyenne atteint 357 oiseaux/km de rivage (164 femelles, 153 mâles et 40 canetons par kilomètre) dans les stations les plus fréquentées du littoral. Certaines stations côtières comme Cacouna, Saint-Fabien, Baie-Sainte-Catherine et Cap-à-l'Orignal semblent être nettement privilégiées par l'eider pour l'élevage des jeunes (juillet et août) tandis que d'autres sont fréquentées surtout par les adultes, mâles et femelles, dans les semaines suivant la reproduction (rivière Tartigou, Pointe-au-Boisvert). La convergence vers l'aval au terme de la période de reproduction est plus marquée chez les femelles sans jeunes et les mâles. Ceci constitue probablement une réponse aux changements d'abondance relative de leur proie principale (*Mytilus*) dans le milieu estuarien. Les canetons et les femelles qui les accompagnent assument, le long du littoral sud, une distribution beaucoup plus uniforme durant les mois de juillet et d'août, ce qui reflète également le schéma d'abondance de la proie principale de ce groupe à cette période, soit les gastéropodes (*Littorina* sp.). Les autres facteurs susceptibles d'influencer la distribution de l'Eider à duvet, c'est-à-dire le degré d'exposition aux intempéries du littoral, et la distance entre les sites de nidification et les stations littorales où prend place l'élevage, ne semblent revêtir qu'une faible importance dans l'établissement de leur schéma général de distribution dans l'estuaire du Saint-Laurent au cours de l'été.

2. Abstract

Regular surveys between April and October in 1972 and 1973 allowed us to describe the distribution of Common Eiders (*Somateria mollissima*) along both shores and around the islands of the St. Lawrence estuary. Mean numbers of males, females, and ducklings per kilometre of shoreline, over the course of the season, show a downstream movement of the population immediately after the nesting season. Mean densities reach 357 birds/km (164 females, 153 males, and 40 ducklings) in the most heavily frequented sites. Sites such as Cacouna, St-Fabien, Baie Ste-Catherine, and Cap-à-l'Orignal represent preferred locations for rearing young (July and August) whereas others are occupied mainly by adult males and females in the weeks following nesting (rivière Tartigou, Pointe-au-Boisvert). The convergence of birds in the lower estuary towards the end of the breeding season is most marked among males and non-breeding females and probably indicates a response to changes in the relative abundance of their chief prey item, *Mytilus*, in the estuary. Ducklings, and the adult females accompanying them, establish a more uniform pattern of distribution, at least along the south shore, during July and August, reflecting the abundance of the principal prey of broods at this time, *Littorina*. Other factors likely to influence Common Eider distribution, such as (1) the degree of protection from inclement weather offered by different rearing sites and (2) distance from nesting islands to rearing locations, are of minor importance in determining the general pattern of summer distribution of the species in the St. Lawrence estuary.

3. Introduction

Nous avons déjà décrit, dans une étude antérieure, l'influence de certains facteurs géographiques et écologiques sur la dispersion des femelles de l'Eider à duvet (*Somateria mollissima*) entre les îlots de nidification et les aires d'élevage côtières des canetons dans l'estuaire du Saint-Laurent (Gauthier et Bédard, 1976). Cette étude était fondée sur les contrôles visuels de 1300 femelles reproductrices marquées à l'aide d'étiquettes patagiales (Anderson, 1963).

Les inventaires réalisés alors pour la détection des femelles marquées à travers les 5000 km^2 de l'estuaire maritime du Saint-Laurent ont également permis la compilation d'informations abondantes et détaillées quant à la dispersion des autres catégories d'eiders : femelles non marquées, avec ou sans jeunes les accompagnant, canetons et mâles adultes. Les nombreuses informations recueillies permettent de décrire les schémas de distribution qui se dessinent pendant la phase critique du cycle annuel que constitue la période d'élevage des canetons (juillet et août). Nous tenterons aussi d'interpréter ces schémas à la lumière de l'information disponible concernant les facteurs susceptibles de les influencer c'est-à-dire : l'exposition du littoral, la distance et la nature des courants entre les aires de nidification et les aires de distribution pendant l'élevage et enfin, l'abondance de la faune littorale servant de substrat alimentaire à l'espèce pendant cette période du cycle annuel.

4. Régions à l'étude

La zone d'observation couvrait tout le littoral accessible par voie terrestre de l'estuaire maritime du Saint-Laurent, entre Rivière-Ouelle et La Malbaie à l'ouest et Sainte-Anne-des-Monts et l'île du Cap Colombier à l'est, (voir figure 1 dans Chapdelaine, Dupuis *et al.*, présente publication) ainsi que le pourtour des îles comprises dans le même territoire. Ce littoral s'étend sur 746 km (rive sud, 420 km; rive nord, 210 km; et pourtour des îles, 116 km) dont 530 étaient accessibles à l'observateur (71 %). Le pourtour de toutes les îles ainsi que 300 des 420 km de la rive sud (71 %) étaient également accessibles. Le relief très prononcé le long de la rive nord de l'estuaire explique pourquoi seulement 114 des 210 km (54 %) de ce littoral ont pu être inventoriés.

Afin de comptabiliser les résultats de ces inventaires, les deux rives de l'estuaire ont été découpées en 51 stations littorales contiguës, constituant des stations physionomiquement homogènes. Ces stations sont limitées à leurs extrémités par des repères terrestres facilement identifiables (promontoires, îlôts, embouchures de rivières, etc.) et mesurant entre 2,3 et 14,1 km de longueur.

Les marées exercent une grande influence dans ce territoire; l'amplitude moyenne est de 3 m alors que l'amplitude maximale atteint un peu plus de 4 m. Les conditions hydrographiques diffèrent profondément entre l'amont et l'aval de l'estuaire : la salinité dans les eaux littorales de la rive sud passe de 15 % environ près de Kamouraska à 30 % près de Matane (Bourget et Lacroix, 1973; Bourget, 1976) tandis que la turbidité suit un gradient inverse entre ces deux mêmes localités (Nota et Loring, 1964). La faune littorale d'invertébrés dont s'alimentent les eiders à cette période (Cantin *et al.*, 1974) montre une profonde réduction de diversité et d'abondance entre l'aval et l'amont causée par ces importants gradients hydrographiques (Bousfield, 1956; Bourget, 1976; Fradette et Bourget, 1980).

5. Méthodes

Les oiseaux furent dénombrés à l'aide de télescopes et répartis dans l'une ou l'autre des catégories suivantes : mâles, canetons, femelles seules et femelles accompagnant des canetons. Cette dernière catégorie ne comprenait que les femelles affichant un comportement de dominance et de «leadership» au sein de la couvée ou de la crèche (exhibant le statut «B» de Bédard et Munro, 1977). Les canetons deviennent difficiles à distinguer des femelles adultes après le 15 août et les résultats d'inventaires postérieurs à cette date ne font plus la distinction.

Les modalités d'inventaire sont données dans Gauthier et Bédard (1976). Toutefois, en raison de problèmes de logistique et de main-d'oeuvre, certaines séries d'inventaires sont moins complètes que d'autres. En outre, nous ne présentons ici que les résultats obtenus en 1972 pour la rive sud et ceux obtenus en 1973 pour les îles et la rive nord de l'estuaire. Bien qu'inhabituelle, cette procédure nous semble justifiée puisque tous les résultats partiels obtenus dans l'une ou l'autre région de l'estuaire confirment à chaque fois les résultats plus complets retenus ici aux fins de la discussion.

À cause de l'immensité du territoire et aussi de contraintes météorologiques et logistiques, le nombre d'inventaires réalisés peut varier d'une station à l'autre et d'une rive à l'autre. Ainsi, les inventaires couvrant la période d'élevage des canetons varient d'un minimum de deux dans une station de la rive nord à un maximum de 12 dans plusieurs stations de la rive sud. Dans le cas des mâles et des femelles, nous disposons des résultats de 7 à 18 inventaires dans les 51 stations littorales. Ces inventaires sont uniformément répartis entre la fin avril et le début de novembre. Le pourtour des îles a été inventorié durant le plus bref intervalle de temps possible à partir de bateaux et d'aéronefs à deux reprises en 1972 (mi-mai et fin juin) et à trois reprises en 1973 (mi-mai, fin juin et mi-juillet). Nous ne ferons état que des résultats obtenus à la mi-juillet 1973. Cet inventaire général couvrait tout le territoire estuarien occupé par les eiders et près de 86 % de tout le milieu littoral fut inspecté durant une période de 72 heures les 13, 14 et 15 juillet 1973.

Certains secteurs de la rive nord, inaccessibles par voie terrestre, ont été occasionnellement inventoriés à partir d'aéronefs et les résultats obtenus ont alors été intégrés aux séries de données normalement obtenues par voie terrestre. Cependant, de tels résultats étaient pondérés par un facteur de correction de 1,25 (Stott et Olson, 1972).

Les résultats ci-dessous (en nombre d'oiseaux par kilomètre de littoral) représentent les valeurs moyennes de tous les inventaires réalisés pour une station littorale donnée.

6. Résultats

6.1. Calendrier de la reproduction □

L'Eider à duvet pénètre dans l'estuaire du Saint-Laurent à la fin du mois d'avril et se répartit dans les différents sites de nidification durant la première moitié de mai. Un inventaire général de l'estuaire à ce moment précis révèle une concentration fortement agglomérée des oiseaux autour des îles servant à la nidification (Reed, 1975 et Chapdelaine, Dupuis *et al.*, présente publication) et une présence réduite dans les stations littorales. Dès la mi-juin, les mâles abandonnent les sites de nidification et se regroupent en bandes homogènes. Certains de ces groupes se forment rapidement dans les régions de la rivière Tartigou sur la rive sud et de Pointe-au-Boisvert sur la rive nord (Gauthier et Bédard, 1976) alors que d'autres semblent quitter entièrement l'estuaire pour une destination inconnue. Enfin, à la mi-juillet, presque tous les oiseaux ont quitté les aires de reproduction et assument alors dans l'estuaire un schéma de distribution qui demeurera à peu près stable jusqu'au milieu du mois d'août. Les canetons accompagnent les femelles dans les aires d'élevage du littoral et, par la suite, ces groupes font preuve d'une assez grande sédentarité (Bé-

Des couvées d'Eiders à duvet s'unissent souvent en groupements ou crèches de plusieurs familles, comme celles-ci près de l'île Bicquette
Common Eider broods often assemble into multi-family groups or crèches, such as this one near Ile Bicquette
(photo: F. Bruemmer)

dard et Munro, 1977; Gauthier et Bédard, 1976).

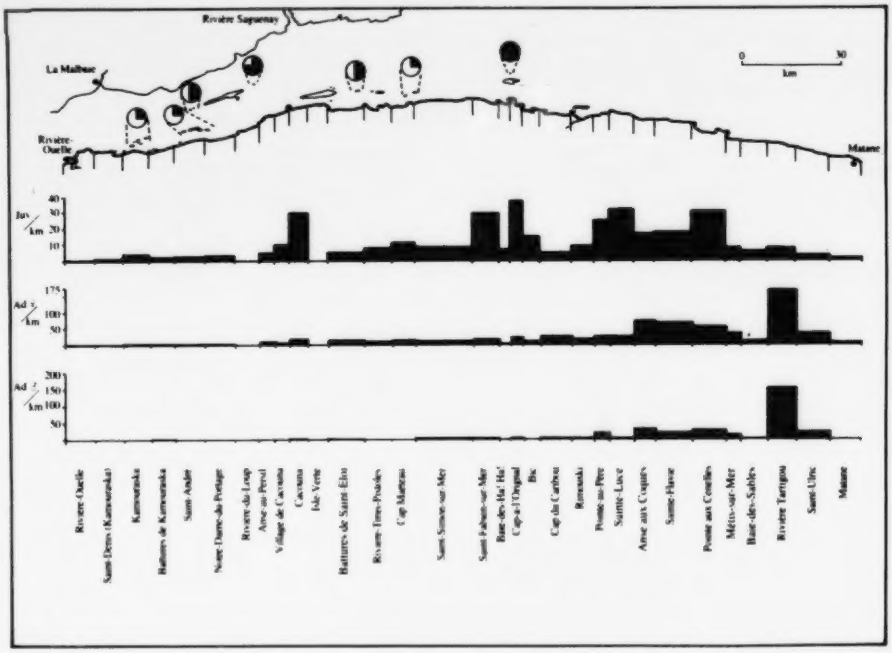
6.2. Résultats des inventaires □

Les valeurs moyennes de densité par station littorale et par catégorie d'oiseaux (canetons, mâles et femelles) sont présentées dans les figures 1 et 2 pour les rives sud et nord respectivement et dans la figure 3 pour le littoral insulaire.

Afin de comparer les stations côtières entre elles quant à leur qualité en tant que sites d'élevage pour les jeunes, nous avons établi trois classes arbitraires de densité d'occupation : 0 à 7,9 jeunes/km de rivage, 8,0 à 17,9 jeunes/km et 18,0 à 40 jeunes/km (figures 1, 2 et 3). Aucune des stations littorales de la rive nord n'atteint le niveau de 18 jeunes/km de rivage alors que 6 des 31 stations de la rive sud dépassent ce seuil de forte densité d'occupation. Seulement 2 des 20 stations de la rive nord ont entre 8,0 et 17,9 jeunes/km de rivage contre 9 stations sur la rive sud. Enfin, 18 stations de la rive nord et 16 stations de la rive sud ont en moyenne moins de 8 jeunes/km de rivage.

La dispersion des canetons à la périphérie des îles révèle une situation plus complexe. Ainsi, certains milieux insulaires qui n'ont que peu ou pas de valeur en tant que site d'élevage (substrat inapproprié, exposition trop grande) abritaient encore au moment de l'inventaire de la mi-juillet, des quantités étonnamment élevées de jeunes canetons (figure 3). Ceux-ci étaient sans doute accompagnés de femelles ayant réussi une reproduction tardive et n'ayant pas encore gagné l'une ou l'autre rive. C'est le cas de l'île Blanche autour de laquelle la densité dépasse 40 canetons/km de rivage et peut-être aussi celui de l'île aux Fraises où cette valeur atteint 7,7 jeunes/km de littoral. Par contre, la situation le long des îles de grande dimension ne servant pas de site de nidification semble conforme à celle qui prévaut sur les littoraux de l'estuaire à la même époque. Ainsi, on trouve une densité de 15 jeunes/km autour de l'île aux Lièvres, de 11 jeunes/km sur le littoral nord de l'île Verte et de 38 jeunes/km autour de l'île aux Basques. De telles densités d'occupation sont comparables à celles mesurées dans de bons sites côtiers offrant protection et ressources alimentaires équivalentes. Quant aux îles de petite dimension et ayant abrité un nombre plus ou moins élevé de nicheurs plus tôt en saison, comme l'île aux Pommes ou l'île Bicquette, elles étaient complètement désertes au moment de l'inventaire de juillet.

Figure 1
Abondance moyenne des diverses catégories d'Eiders à duvet en nombre d'individus par kilomètre de rivage le long de la rive sud de l'estuaire maritime du Saint-Laurent en 1972
Mean number of Common Eiders, by category, per kilometre of shoreline, along the south shore of the lower St. Lawrence estuary, 1972



NOTE: Le nombre d'inventaires varie de 7 à 18 entre les stations littorales (voir texte). L'augmentation de la fréquence des inventaires durant la période d'élevage des jeunes (juillet et août) accentue sensiblement dans le schéma ci-dessus l'importance de certaines stations littorales en rapport avec cette partie du cycle annuel. Certaines stations littorales peu ou moyennement utilisées à cette période peuvent revêtir une importance considérable durant certaines courtes périodes.

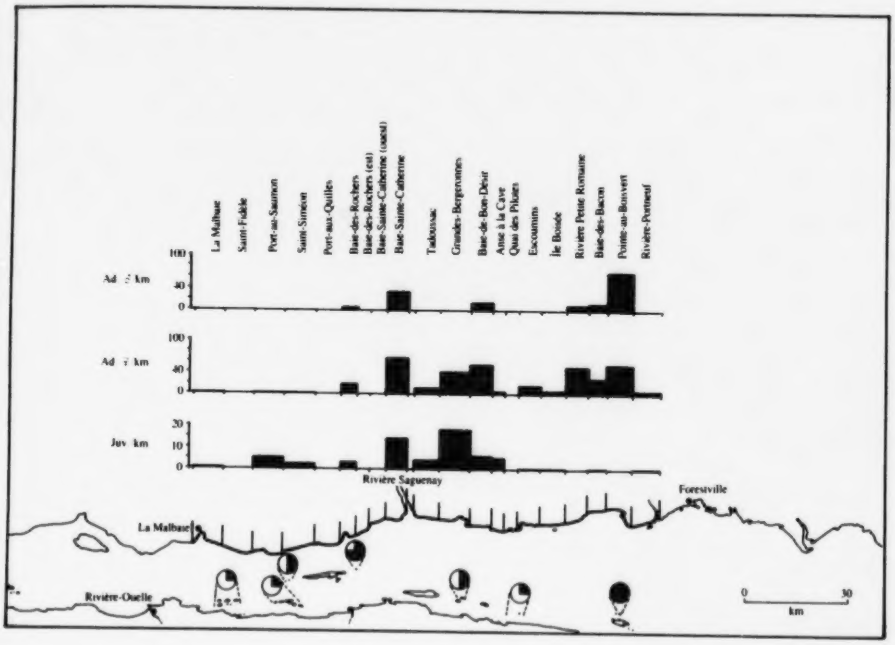
NOTE: The number of surveys varied from 7 to 18 for different sectors (see text). The increased frequency of surveys during the brood-rearing period (July and August) distorts the seasonal pattern in favour of those sites used most heavily by broods. Certain sectors moderately or little used by broods can be important for short periods.

Certaines stations littorales, comme Sainte-Flavie ou la pointe aux Cenelles (figure 1) peuvent offrir, outre de bonnes conditions pour les jeunes, des conditions aussi recherchées tant par les femelles que par les mâles. Cette situation est illustrée par les résultats détaillés des inventaires effectués à la station de Sainte-Flavie (figure 4). Cette station, caractérisée par un littoral rocheux (schiste) exposé, est presque totalement abandonnée par les oiseaux pendant la période de nidification. Toutefois, très tôt après le début de la phase d'éclosion, des canetons apparaissaient le long du littoral et leur nombre a rapidement atteint 425 individus à la fin de juillet. Les mâles semblent également converger vers cette station côtière; le 19 juillet, 700 mâles y furent dénombrés. L'absence momentanée de ce groupe lors de l'inventaire du 10 août s'explique par une anomalie passagère d'échantillonnage plutôt que par un abandon de la station. Ces oiseaux étaient probablement présents mais dans la zone infra-littorale c'est-à-dire hors de portée de l'observateur lors de cet inventaire. Les femelles semblent aussi privilégier cette station littorale et leur abondance saisonnière moyenne s'y établit à 67 individus/km de rivage.

Onze stations côtières offrent des conditions moyennes pour l'élevage (8,0 à 17,9 jeunes/km). À l'exception de l'anse aux Coques (figure 1) et de Baie-Sainte-Catherine (figure 2), ces stations sont généralement favorisées presqu'exclusivement par des groupes de jeunes accompagnés d'un petit nombre de femelles. Les stations de Cacouna, du cap Marteau, de Bic et de Rimouski sont de bons exemples de ce type de station littorale.

Finalement, les stations dans lesquelles la densité d'occupation par les canetons est basse (0 à 7,9 jeunes/km) sont de plusieurs types. Certaines, comme celle de la rivière Tartigou, de la baie de Bon-Désir, de la rivière Petite Romaine et de Pointe-au-Boisvert sont probablement trop éloignées des sites de nidification pour être colonisées par des couvées ou des crèches mais offrent, semble-t-il, des conditions

Figure 2
Abondance moyenne des diverses catégories d'Eiders à duvet en nombre d'individus par kilomètre de rivage le long de la rive nord de l'estuaire maritime du Saint-Laurent en 1973
Mean number of Common Eiders, by category, per kilometre of shoreline along the north shore of the lower St. Lawrence estuary in 1973



Note : Le nombre d'inventaires varie de 2 à 13 entre les stations littorales (voir texte). L'augmentation de la fréquence des inventaires durant la période d'élevage des jeunes (juillet et août) accentue sensiblement dans le schéma ci-dessus l'importance de certaines stations littorales en rapport avec cette partie du cycle annuel. Certains inventaires ont été réalisés à partir d'aéronefs et les valeurs obtenues ont alors été pondérées par un facteur de 1,25 tenant compte de la difficulté de détection des oiseaux.

Note: The number of surveys varied from 2 to 13 for different sectors (see text). The increased frequency of surveys during the brood-rearing period distorts the seasonal pattern in favour of those sites used most heavily by broods. The results of aircraft surveys were expanded by a factor of 1.25 to account for difficulties of detection.

exceptionnelles pour les oiseaux adultes (par exemple, la rivière Tartigou et Pointe-au-Boisvert). D'autres stations comme Métis-sur-Mer et le cap du Caribou abritent non seulement peu de canetons mais aussi peu d'adultes mâles ou femelles (figure 1).

Si on divise l'estuaire du Saint-Laurent par une ligne imaginaire reliant l'embouchure du Saguenay et l'île Verte, les sites de nidification et la population reproductrice sont divisés en deux parties à peu près égales. Selon Reed (1975), la population nichant actuellement sur les îles en amont de cette ligne est d'environ 9000 couples alors que celle nichant sur les îles en aval est près de 10 500 couples. Cependant, la distribution des oiseaux tôt après la saison de reproduction (figures 1, 2 et 3) révèle une asymétrie prononcée avec la situation qui prévalait pendant la saison de reproduction. La proportion d'oiseaux amont/aval après la reproduction a changé radicalement. De toute évidence, les oiseaux de toutes les catégories se déplacent considérablement en aval aussitôt après l'abandon des sites de nidification. Ce déplacement se manifeste autant sur la rive sud que sur la rive nord, mais semble affecter davantage les mâles que les femelles (figure 1, rive sud principalement), et davantage les femelles que les canetons. Même si les femelles convergent très nettement vers les stations en aval, elles sont malgré tout présentes en petits nombres dans presque toutes les stations littorales. Environ la moitié de ces femelles accompagnent alors des canetons et leur distribution moins asymétrique que celle des mâles est alors compréhensible.

Les résultats de l'inventaire exhaustif de la mi-juillet 1973 (86 % de tout le littoral estuarien examiné en 72 heures) sont présentés au tableau 1. Cet inventaire a permis de dénombrer 22 528 adultes sur une population totale de 40 000 individus environ (Reed, 1975). Il faut noter cependant que 18 480 femelles, ou 92 % de toutes les femelles reproductrices, ont été repérées durant ces trois jours. Le tableau 1 révèle aussi la distribution des mâles en même temps qu'il donne un aperçu de la production totale estimée de canetons pour cette population. Cependant le nombre de jeunes (6139) relevé à un stade précoce de l'élevage ne peut pas être assimilé au recrutement puisque la mortalité affectera considérablement ce contingent avant même que les oiseaux n'atteignent d'abord l'âge d'envol, vers la fin du mois suivant puis, l'âge de la reproduction, trois ans plus tard.

D'après les résultats du tableau 1, on constate qu'à peine 8,7 % des femelles repérées accompagnaient des canetons (2132/18 480) à la mi-juillet : cette proportion est appelée à décroître davantage à mesure que la saison progresse et que les crèches évoluent.

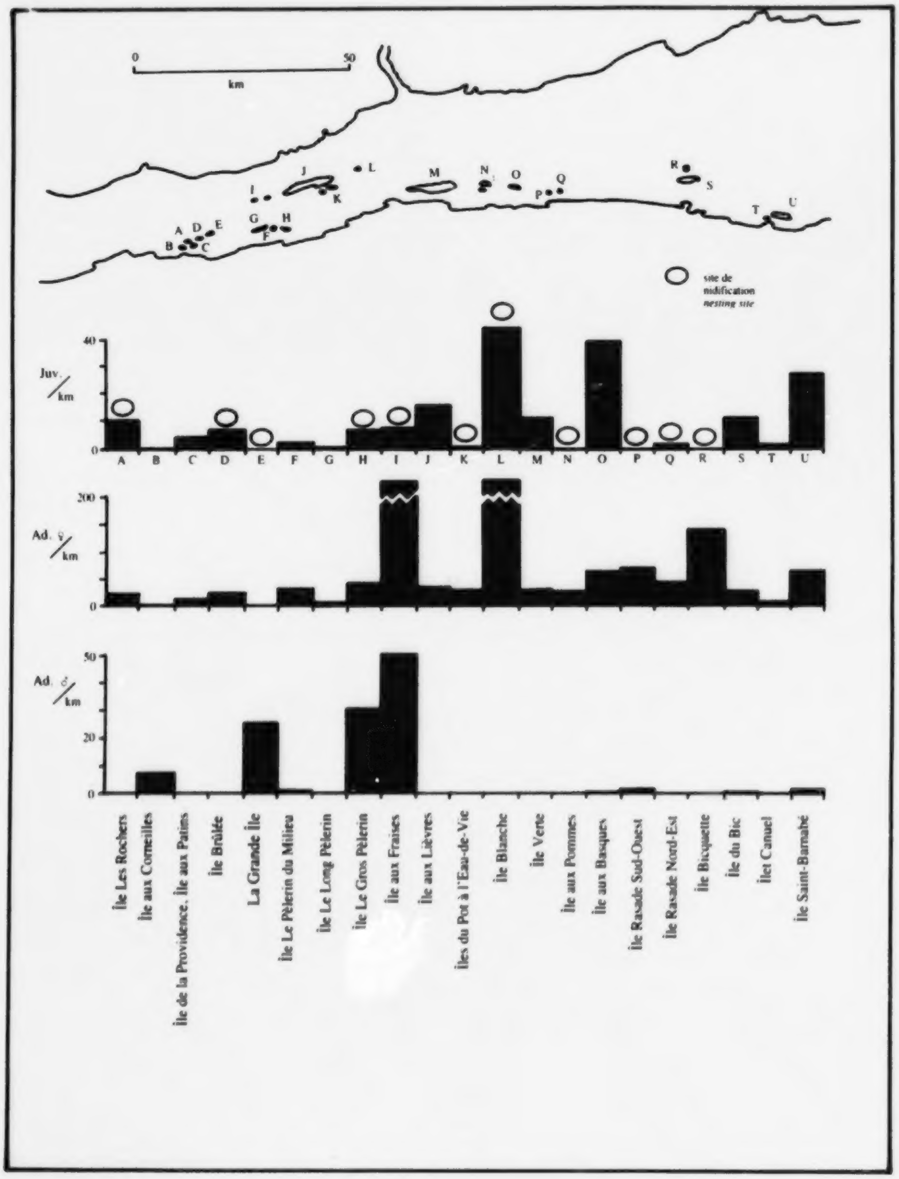
7. Analyse

L'utilisation de valeurs moyennes fondées sur des inventaires répartis inégalement durant toute la saison (figures 1 et 2) biaise quelque peu les estimations relatives de densité obtenues pour chacune des stations littorales. Une accentuation de la fréquence des inventaires durant la période d'élevage augmente sans doute l'importance de cette phase du cycle annuel dans l'image d'ensemble de la distribution de l'Eider à duvet dans l'estuaire du Saint-Laurent. Aussi, les valeurs compilées dans les figures 1 et 2 doivent-elles être interprétées comme des indices relatifs d'intensité d'utilisation. Il est possible que certaines stations littorales reçoivent une fréquentation extrêmement intensive pendant une brève période et que ce phénomène ne soit pas perceptible à l'examen de l'une ou l'autre de nos figures.

Notre inventaire de la mi-juillet 1973 ne nous a pas permis de détecter tous les eiders de l'estuaire. Comme les mâles semblent alors avoir quitté l'estuaire (Gauthier et Bédard, 1976), notre faible pourcentage (20 %) de mâles repérés ne nous étonne pas. Cependant, la détection de 18 500 femelles reproductrices laisse supposer que notre schéma de distribution ainsi que notre relevé de 6139 canetons vivants à la mi-juillet est relativement bon. Les résultats du recensement des femelles sont remarquables quand on considère que certains oiseaux pouvaient échapper à l'observateur au moment de l'inventaire. Notons également que l'absence de femelles et de mâles sous-adultes dans l'estuaire du Saint-Laurent simplifie l'établissement de ces relations. En effet, au cours de nos travaux, nous n'avons observé que des individus isolés de cette catégorie.

Le schéma de distribution décrit à la mi-juillet demeurera stable pendant cinq semaines environ. Le contrôle des oiseaux

Figure 3
Abondance moyenne des diverses catégories d'Eiders à duvet en nombre d'individus par kilomètre de rivage autour des îles de l'estuaire maritime du Saint-Laurent les 13, 14 et 15 juillet 1973
Mean number of Common Eiders, by category, per kilometre of shoreline of islands in the lower St. Lawrence estuary, 13–15 July 1973



Note: Certaines îles de petite dimension sont fréquentées par des quantités anormalement élevées d'oiseaux (île Blanche par exemple) à la mi-juillet. Un peu plus tard en saison, ces îles seront normalement désertées.

Note: Some smaller islands (e.g., Île Blanche) are frequented by abnormally high numbers of birds in mid-July. Later in the season those islands are usually deserted.

marqués nous a permis de démontrer une grande fidélité des crèches à des sites côtiers spécifiques jusqu'à l'envol des jeunes, de 65 à 70 jours plus tard (Gauthier et Bédard, 1976). McAloney (1973) qui a observé une fidélité à un site d'élevage pendant une période de 35 à 50 jours en Nouvelle-Écosse, est arrivé aux mêmes conclusions. Nordberg (1942) a aussi constaté pareil attachement à une aire d'élevage. À notre avis, le profil de distribution donné par l'inventaire de la mi-juillet représente une image assez fidèle de l'utilisation que fait l'eider des différents milieux littoraux de l'estuaire du Saint-Laurent. De façon très générale, il apparaît donc que les eiders favorisent d'abord la rive sud, ensuite la rive nord de l'estuaire et finalement le milieu insulaire (tableau 1).

L'abondance des oiseaux n'est pas le fruit du hasard. Bien au contraire, les oiseaux semblent choisir délibérément la station côtière qu'ils vont utiliser durant les semaines qui suivent la nidification. C'est ainsi que les oiseaux originaires de l'île Bicquette délaissent des stations littorales comme le cap du Caribou ou Baie-des-Ha!Ha! (figure 1) au profit des sites comme Sainte-Luce ou la pointe aux Cenelles à 15 ou 30 km plus en aval. Les facteurs déterminant ce choix et, par conséquent, le schéma de distribution que nous venons de décrire, sont probablement nombreux et complexes et nous ne pouvons en faire ici qu'une évaluation sommaire et *a posteriori*. Néanmoins, nous croyons être en mesure d'identifier et de hiérarchiser ces principaux facteurs :

1. *Protection offerte par le découpage littoral* : un certain nombre d'auteurs dont Salomonsen (1968), Roed (1971), Jepsen (1973) et surtout Campbell (1974) ont mis en évidence l'importance de la configuration des berges sur la dispersion des canards de mer. Ce dernier a mis au point un indice numérique permettant de prédire le niveau d'utilisation d'une station littorale par divers canards plongeurs en combinant des caractéristiques d'orientation du littoral, de son découpage et de la grandeur du bassin maritime adjacent. Cette étude, réalisée en hiver sur le littoral de la Mer du Nord mène cependant à des conclusions qui ne s'appliquent guère à la situation qui prévaut dans l'estuaire du Saint-Laurent. En effet, dans sa plus grande largeur, l'estuaire maritime atteint à peine 50 km. De plus, les tempêtes estivales sont moins sévères que celles de la Mer du Nord. Enfin, dans certains cas, l'Eider à duvet recherche des secteurs côtiers rectilignes n'offrant aucune protection contre les intempéries plutôt que des secteurs échancrés offrant d'excellentes condi-

tions de protection contre les éléments. C'est ainsi que Sainte-Luce, Sainte-Flavie, Grandes-Bergeronnes et Baie-Sainte-Catherine acceuillent de fortes populations d'oiseaux le long de berges très exposées et que des stations relativement abritées comme l'île Verte ou Bic sont à peu près ignorées par les oiseaux. En résumé, nous ne croyons pas que la protection offerte par le découpage littoral, facteur influent dans certaines circonstances, ait une importance quelconque dans le cas de notre étude.

2. *Distance entre les sites de nidification et d'élevage* : ce facteur, n'influençant que les canetons et les femelles qui les accompagnent, explique certainement quelques aspects des schémas de distribution révélés dans les figures 1 et 2. Ainsi, la faible abondance de canetons à l'est de l'anse à la Cave sur la rive nord du fleuve s'explique sans doute par la distance considérable (40 km) entre ce point et le site de nidification le plus rapproché, soit l'île Blanche. Il faut aussi mentionner qu'il existe dans cette région des courants de surface qui tendent à déporter les oiseaux vers la rive sud (Gauthier et Bédard, 1976). Cependant, les oiseaux peuvent franchir de grandes distances même dans les heures qui suivent l'éclosion. Cooch (1965) a signalé que des eiders de Cape Dorset dans les Territoires du Nord-Ouest entraînaient leurs canetons jusqu'à 80 km de leur île d'origine très tôt après l'éclosion. Nous avons nous-mêmes enregistré le déplacement de femelles marquées accompagnées de canetons de moins d'une semaine sur des distances atteignant 100 km (Gauthier et Bédard, 1976). Nous concluons donc que le présent facteur peut expliquer certains aspects mineurs des schémas observés mais qu'en général, les oiseaux peuvent atteindre n'importe quel site d'élevage favorable pourvu qu'il soit dans un rayon d'une centaine de kilomètres du point d'origine.

3. *L'abondance de nourriture* : ce facteur est à notre avis le plus important. L'Eider à duvet préfère des proies que l'on retrouve sur des substrats durs et qui sont surtout abondantes dans les niveaux médiolittoral moyen et inférieur. Il s'agit de petits gastéropodes surtout du genre *Littorina* dans le cas des canetons et des femelles qui les accompagnent (Cantin *et al.*, 1974). On croit par contre que dans l'estuaire du Saint-Laurent comme ailleurs dans l'hémisphère nord, les adultes (femelles sans jeunes et mâles) préfèrent la moule bleue (*Mytilus edulis*) (Milne, 1968; Pethon, 1967). La distribution de ces deux types principaux d'organismes proies a été bien étudiée dans la zone littorale de l'estuaire maritime du Saint-Laurent : Bourget (1976) a observé que l'abondance des moules et des pélécypodes en général diminue gra-

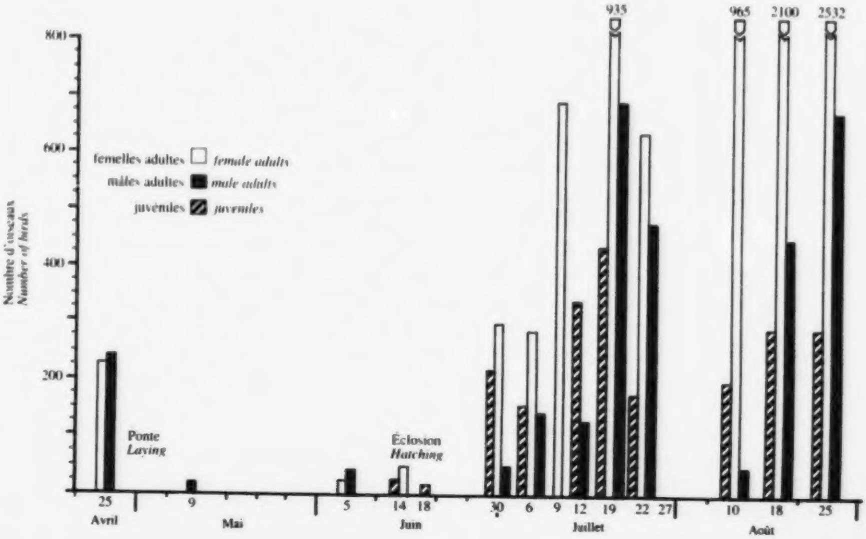
Tableau 1
Résultats de l'inventaire général de la mi-juillet 1973 pour chacune des grandes régions de l'estuaire maritime du Saint-Laurent obtenus à partir d'aéronefs, de bateaux et de postes d'observation terrestres
Results of a general survey in mid-July 1973, covering all of the major sectors of the lower St. Lawrence estuary, using aircraft, boats, and ground lookouts

	Longueur du littoral inventorié, km *Length of shore-line surveyed, km*	Nombre total d'Eiders à duvet aperçus *Total number of Common Eiders recorded*				
		♂	♀ sans jeunes ♀ *without young*	♀ avec jeunes ♀ *with young*	Jeunes *Young*	Total
Rive nord* *North shore**	189 (29 %)	1403	5 887	584	1033	8 907
Pourtour des îles *Island shorelines*	116 (18 %)	264	4 778	514	1488	7 044
Rive sud *South shore*	337 (53 %)	2381	5 683	1034	3618	12 716
Total	642	4048	16 348	2132	6139	28 667

* Les résultats provenant de la rive nord, obtenus par avion, ont été ajustés à la hausse de 25 % dans le cas des adultes et de 50 % dans le cas des canetons (Stott et Olson, 1972) afin de compenser pour les difficultés accrues de détection.

* *The surveys along the north shore were done by aircraft; the results have been expanded by 25% for adults and 50% for ducklings to account for difficulties of detection (Stott and Olson 1972).*

Figure 4
Résultats détaillés des inventaires dans la station littorale de Sainte-Flavie (rive sud) en 1973, en nombre absolu d'oiseaux détectés à chacun des inventaires
Numbers of birds recorded on surveys in the Ste. Flavie (south shore) sector in 1973



duellement à mesure qu'on pénètre dans l'estuaire. Alors que cette espèce peut atteindre une biomasse de 150 g/m² dans le médio-littoral de Saint-Ulric ou de Baie-des-Sables, cette valeur n'atteint plus qu'environ 20 g/m² un peu en amont de Rimouski. À mesure qu'on pénètre plus avant dans l'estuaire, cette espèce se restreint de plus en plus au niveau inférieur du littoral et son abondance décroît encore davantage jusqu'à en devenir nulle aux environs de Kamouraska. La turbidité croissante de l'eau vers l'amont semble jouer un rôle prédominant dans ce changement d'abondance (Bourget, comm. pers.). Par contre, les gastéropodes ne représentent généralement qu'une faible biomasse en raison de leur petite taille, soit ordinairement moins de 15 g/m² (Bourget, 1976). Ils ont toutefois une distribution beaucoup plus régulière, tout au moins le long de la rive sud de l'estuaire maritime. Leur abondance reste proportionnellement élevée dans les niveaux médio-littoral moyen et supérieur chaque fois que le substrat est convenable et aussi loin en amont que des stations comme Cacouna et Kamouraska. La convergence des adultes vers les stations les plus à l'est de l'estuaire maritime tôt après la reproduction est probablement liée à la distribution particulière de cette proie préférée que constitue le *Mytilus*. Cet organisme est susceptible d'offrir de bonnes conditions d'alimentation pour des oiseaux dont les besoins sont considérables (femelles récupérant les importantes pertes de poids subies pendant l'incubation, mâles immobilisant le plus de réserves possibles face aux demandes accrues survenant en période de mue). La dispersion beaucoup plus uniforme des canetons (du moins le long de la rive sud de l'estuaire) semble également résulter d'une harmonisation avec la distribution des gastéropodes qui constituent entre 40 et 90 % de toute l'alimentation selon le moment de la saison (Cantin *et al.*, 1974). Le *Mytilus* ne constitue pas un aliment approprié pour les canetons. Certains auteurs ont même suggéré que les petits gastéropodes ne constituaient pas davantage un substrat alimentaire adéquat pour les femelles qui accompagnent les canetons durant l'élevage (Gorman et Milne, 1972) puisque les pertes pondérales subies pendant l'incubation ont affecté ces individus plus que tous les autres. Cependant, ces vues ne semblent pas s'appliquer à la situation qui prévaut dans l'estuaire du Saint-Laurent.

Donc, la distribution de l'Eider à duvet tôt après la reproduction correspondrait sensiblement aux schémas de distribution de ses proies préférées. L'abondance de celles-ci est à son tour influencée par la disponibilité de substrats durs. Les stations littorales abritant les plus grandes densités d'eiders de toutes les catégories sont précisément des stations localisées sur de tels substrats. C'est le cas de la rivière Tartigou (324 oiseaux/km de rivage) et de la pointe aux Cenelles, (106 oiseaux/km). Minot (1980) qui analysa la distribution de l'Eider à duvet à Grand Manan (Nouveau-Brunswick) fait aussi des constatations semblables.

En conclusion, l'asymétrie observée dans les figures 1 et 2 et la tendance prononcée des oiseaux à converger vers des stations en aval tôt après l'éclosion constitueraient principalement une réponse à la distribution des ressources alimentaires. Certains aspects moins importants de ce schéma seraient aussi influencés par la distance entre les sites de nidification et les sites d'élevage. Enfin, les contraintes physiques causées par l'exposition plus ou moins prononcée du littoral ne semblent pas déterminer le choix des eiders quant à la station littorale où ils passeront les six à huit semaines suivant la nidification.

Les résultats présentés ci-dessus décrivent la situation qui prévalait en 1973. Nous soulignons cependant que les observations moins complètes de 1972 révélaient un schéma assez semblable dans le cas des mâles et des canetons. Cependant, les femelles n'accompagnant pas de canetons ne semblaient pas privilégier la rive nord durant 1972 aussi fortement qu'en 1973 et nous ne comprenons pas les raisons qui ont pu causer pareilles différences.

Le pourcentage de femelles accompagnant des canetons est resté remarquablement faible durant les deux années de l'étude soit 7 % en 1972 et 9 % en 1973 (valeurs pour la mi-juillet). Nous estimons qu'au terme de la saison d'élevage, à la fin août, à peine 5 % des femelles reproductrices accompagneront encore des jeunes oiseaux.

Même si la situation décrite ci-dessus est statique et ne peut être interprétée que partiellement et *a posteriori*, nous croyons qu'elle puisse servir de point de référence à d'autres travaux. Nous espérons que des études ultérieures seront réalisées sur l'écologie alimentaire et sur d'autres aspects de l'histoire naturelle de l'Eider à duvet dans l'estuaire du Saint-Laurent, et qu'il sera possible d'en comparer les résultats à ceux que nous publions maintenant. Peut-être pourrions-nous, à la lumière de telles comparaisons, présenter un programme d'observations plus critiques et déterminantes afin de proposer de meilleures explications des schémas de distribution.

8. Remerciements

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Status and movements of Common Eiders in the Maritime Provinces

État de la situation et déplacements des Eiders à duvet dans les Maritimes

A.J. Erskine
A.D. Smith

1. Abstract

Eiders in the Maritimes are largely restricted at all seasons to shores that are neither steep nor underlain by sedimentary rocks. Breeding in New Brunswick is concentrated in the southwest, where about 7000 pairs of *Somateria mollissima dresseri* breed. In Nova Scotia, over 1000 pairs breed in the southwest, but the bulk of the population of about 8000 pairs breeds along the Eastern Shore from Jeddore to Canso. The eiders of the Eastern Shore and southwest Nova Scotia, and of New Brunswick winter from southern Nova Scotia to Massachusetts. Eiders from the St. Lawrence estuary move along the coasts of the Maritimes to winter largely in New England, as do a few of the eiders from Labrador. Some eiders reared in Maine move to southern Nova Scotia in their first winter. Fall migration peaks most often in October, but commonly extends from mid-September to mid-December. Most eiders reared in or passing through the Maritimes winter farther south, with probably no more than 10 000 birds remaining from mid-December to mid-February, mainly in the extreme southwest. Spring migration is concentrated in April, but Maritimes breeding stocks may have already reached their nesting areas early in that month. Overland migration, between the Bay of Fundy and Northumberland Strait, is much more common in spring, when the bulk of the St. Lawrence estuary eiders may use this route; in fall, at least as many are believed to follow the coast to the Strait of Canso as migrate overland. Necessary research includes more precise estimates of certain breeding stocks, with ground verification of aerial survey data; additional banding and visible migration studies; and assessment of the proportion of *borealis* eiders in the Maritimes' hunting kill.

2. Résumé

Dans les provinces maritimes, l'Eider à duvet (*Somateria mollissima dresseri*) se rencontre toute l'année le long des côtes peu escarpées, là où la roche-mère n'est pas de type sédimentaire. Au Nouveau-Brunswick, la majorité des couples nicheurs se concentrent dans la partie sud-ouest de la province où se trouvent environ 7000 couples. En Nouvelle-Écosse, plus de 1000 couples nichent dans la partie sud-ouest de la province alors que la majeure partie des effectifs, soit environ 8000 couples, fréquentent les îles de la côte est depuis Jeddore jusqu'à Canso. Les eiders des côtes est et sud-ouest de la Nouvelle-Écosse, ainsi que ceux du Nouveau-Brunswick, hivernent depuis le sud de la Nouvelle-Écosse jusqu'à la côte du Massachusetts. Les Eiders à duvet de l'estuaire du Saint-Laurent et quelques-uns venus du Labrador fréquentent aussi les côtes des provinces maritimes au moment de leurs migrations vers la Nouvelle-Angleterre. Quelques jeunes eiders nés sur la côte du Maine se rendent aussi jusqu'au sud de la Nouvelle-Écosse afin d'y passer leur premier hiver. La migration automnale s'échelonne depuis la mi-septembre jusqu'à la mi-décembre, atteignant son point culminant en octobre. La plupart des eiders qui nichent dans les Maritimes ainsi que d'autres qui s'y attardent en migration, descendent plus au sud, ne laissant qu'environ 10 000 individus à passer la période de la mi-décembre à la mi-février dans l'extrême sud-ouest des Maritimes. La migration du printemps se déroule principalement en avril; les nicheurs locaux atteignent leurs sites de nidification dès le début du mois. Une migration au-dessus de la terre ferme est particulièrement courante au printemps alors que de nombreux eiders franchissent l'Isthme de Chignecto séparant la baie de Fundy du détroit de Northumberland. La majeure partie de la population de l'estuaire du Saint-Laurent semble emprunter cette route au printemps tandis qu'à l'automne la plupart des eiders suivent une route côtière passant par le détroit de Canso. On suggère des études futures visant à obtenir des estimations plus précises de certaines populations nicheuses, le perfectionnement des méthodes d'inventaires aériens, l'approfondissement des connaissances sur la migration utilisant les méthodes visuelles et le baguage, de même que l'évaluation de la proportion de *S.m. borealis* parmi les eiders tués par les chasseurs des Maritimes.

3. Introduction

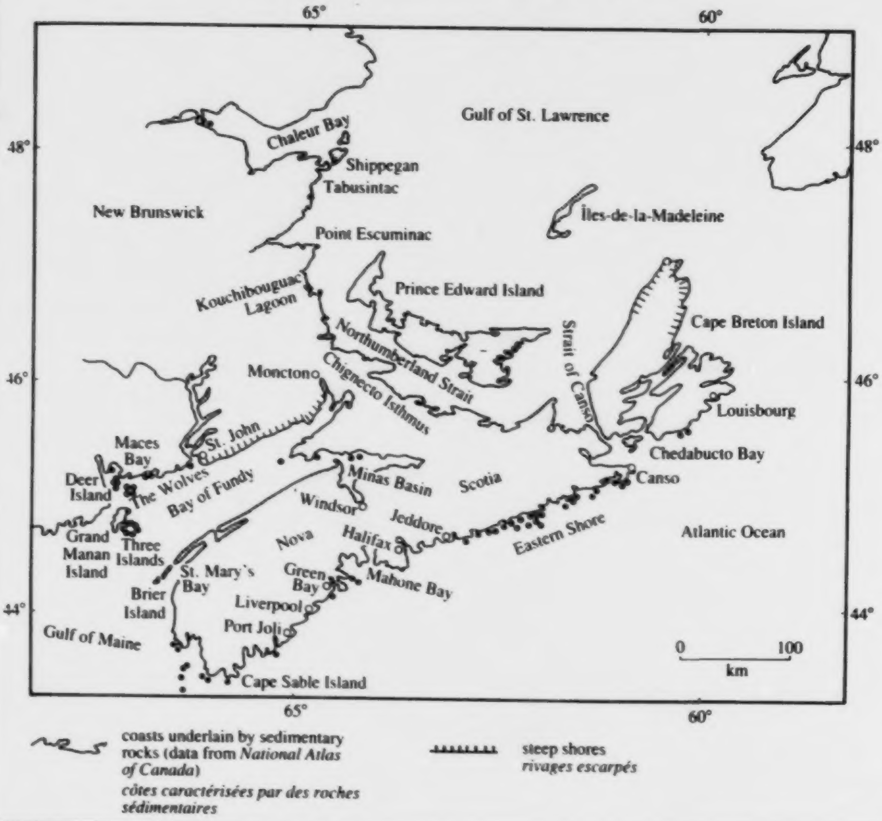
Common Eiders occur in the Maritimes (the provinces of Nova Scotia, New Brunswick, and Prince Edward Island) in all months of the year. Only three thesis projects (Sabean 1972, McAloney 1973, Minot 1976) and one early report (Gross 1938) are specifically directed at eiders in the Maritimes. Palmer (1976) summarized eider data available through 1971, but from a much broader perspective. In his handbook not all sources of information could be given but we presume that most were among those consulted by us. Our interpretation of certain events differs from his, largely because of our access to more recent data and to more obscure local sources. Information accumulated over the last 20 years indicates that the status of "permanent resident" accorded the eider by Tufts (1962) was an oversimplification, and even the broader "summer resident, transient, and winter resident" of Squires (1976) tells only part of the story. In the absence of detailed studies, our information is far from complete, but we can now sketch the movements that connect the six or more eider stocks that frequent the Maritimes during the year with their respective breeding areas.

The purpose of this paper is to summarize existing information on the distribution, numbers, and movements of Common Eiders in the Maritime Provinces through the year. The information is presented first for eiders breeding within the Maritimes, followed by fall migration, wintering birds, and spring migration. In closing, we emphasize major gaps in knowledge, known problems in eider management, and recommendations for future studies.

4. Breeding eiders of the Maritimes

For eiders, as for other ducks, the essential requirements for breeding are adequate food supplies within a short

Figure 1
Locations of known breeding sites of eiders in the Maritimes
Localisation des sites connus de nidification de l'Eider à duvet dans les Maritimes


65°
60°
48°
46°
44°
Gulf of St. Lawrence
Chaleur Bay
Shippegan
Tabusintac
New Brunswick
Point Escuminac
Îles-de-la-Madeleine
Kouchibouguac Lagoon
Prince Edward Island
Northumberland Strait
Strait of Canso
Cape Breton Island
Moncton
Chignecto Isthmus
Louisbourg
St. John
Maces Bay
Deer Island
The Wolves
Bay of Fundy
Minas Basin
Scotia
Chedabucto Bay
Canso
Windsor
Jeddore
Eastern Shore
Atlantic Ocean
Grand Manan Island
Three Islands
Nova
Halifax
St. Mary's Bay
Brier Island
Green Bay
Mahone Bay
Liverpool
Port Joli
Gulf of Maine
Cape Sable Island
0
100
km
coasts underlain by sedimentary rocks (data from *National Atlas of Canada*)
côtes caractérisées par des roches sédimentaires
steep shores
rivages escarpés

distance of both safe nesting islands and suitable brood-rearing habitats. A dissected coastline with small islands and reefs scattered over a shallow subtidal area meets these requirements well. In the Maritimes, eiders are absent (except during migration) from those coasts underlain by sedimentary rocks, chiefly sandstones, of carboniferous age, including the east coast of New Brunswick, the north coast of Nova Scotia, and all of Prince Edward Island (Fig. 1). Nearshore islands and reefs are virtually lacking in those areas and also along the steep coasts of northern Cape Breton Island and the middle reaches of the Bay of Fundy. The breeding distribution of eiders is thus confined to southwestern New Brunswick and the outer (Atlantic) coasts of mainland Nova Scotia, except for small groups on Chaleur Bay, the Minas Basin, and off southern Cape Breton Island (Fig. 1).

Data from ground counts for known New Brunswick breeding areas are summarized in Table 1. Only locations with nesting data are included, except where brood records were adjacent to potential nesting islands for which no nest records were available. The aerial survey data presented by Lock (this publication) provide the most consistent estimate of total numbers, and emphasize the inadequacy of existing ground survey data for this area. Chaleur Bay probably supports up to 150 breeding pairs of eiders. Islands adjoining southwestern New Brunswick, including the Deer Island – Campobello Island group, may support as many as 2800 pairs, with a further 1300 pairs on The Wolves and 2700 pairs in the Grand Manan archipelago (Lock, this publication). We cannot exclude the possibility of some movement between these groups, so the discrepancies between the existing ground data and the aerial counts are not surprising. Minot's (1976) estimate of 3500 pairs in the Grand Manan group, mainly on the Three Islands (Kent, Hay, Sheep), seems of the correct order, but he gave no details on how that estimate was obtained. An estimate for the Three Islands in 1981 (J. Bédard for Société Duvetnor, pers. commun.) indicated about 1100 pairs, and three counts of drakes around Kent Island on file in the Bowdoin College field station also showed 1000–1300 in all; these figures do not support Minot's assertion that most eiders around Grand Manan breed in the Three Islands. Additionally, we suspect that a few pairs of eiders may breed on Grindstone Island in Shepody Bay (see Fig. 2); although no nests were found in a survey of the island in 1978, pairs are seen each year off Mary's Point and Cape Maringouin, the nearest areas with potential brood-rearing habitat. In total then, the breeding eider population of New Brunswick is probably close to 7000 pairs.

Data for Nova Scotia breeding areas are presented in Table 2, with similar restrictions as for New Brunswick. Although counts are available for more islands than in New Brunswick, there is no possibility for direct extrapolation. Lock's (this publication) aerial counts provide the most systematic estimate for the major breeding areas. The breeding population on the upper Bay of Fundy is evidently small, probably no more than 100 pairs. Although Lock noted 83 adult drakes around Brier Island, there is no evidence that the species actually breeds there, as offshore islets are lacking, and terrestrial predators probably preclude nesting on the main island. Southwestern Nova Scotia apparently supports over 1000 pairs, whereas the stretch from Cape Sable to Halifax has only about 400 pairs. The Eastern Shore is the centre of abundance of the breeding eiders of Nova Scotia, although Lock's figure of some 6300 pairs is well below the ballpark guess of 10 000 pairs that has been offered in recent discussions. Fewer than 300 pairs were found between Canso and Louisbourg, in Chedabucto Bay, and along the south shore of Cape Breton Island. The total breeding eider population of Nova Scotia is thus around 8000 pairs. Table 3 summarizes available breeding data by coastal area for the Maritimes.

Eiders were formerly abundant throughout the potential breeding range in the Maritimes, but direct exploitation by humans and destruction by domestic animals (dogs, cats, rats) nearly extirpated the species here by 1920 (Bent 1925). There is now little persecution in the breeding season, and many formerly settled islands are now uninhabited or only seasonally occupied, so the inroads of domestic animals are also less. Eider numbers are still increasing in Nova Scotia (Harris 1979) but it seems possible that the New Brunswick population has levelled out, as recent estimates for Grand Manan are not much greater than the 1949 estimate given by Squires (1952). Most coasts that lack breeding eiders have few suitable nesting islands, so future increases are likely only where suitable habitat remains unoccupied within presently used areas.

Most eiders breed first at an age of 3 years or more (Baillie and Milne 1982) so two year-classes of non-breeding birds are present in summer in addition to the breeding population. Many of these are included among the female-like birds seen around the breeding areas, but they are not confined to such locations. Groups of presumably non-breeding eiders are regularly seen around the shores of the southern Gulf of St. Lawrence and Northumberland Strait, but numbers are small, aerial surveys of the east coast of New Brunswick from mid-May through July having found only 60–140 birds (CWS, unpubl. data). Palmer (1976) quoted Boyer (1966) regarding large moulting concentrations of eiders off Prince Edward Island. We have not located or heard of large concentrations there in recent years, and we know of no substantiating evidence for their past occurrence; possibly Boyer's statement was based upon an exceptional event.

Once nesting is underway, the adult males concentrate into flocks, many of which frequent areas where no nesting occurs, so counts of drakes after mid-May are not helpful in plotting breeding distribution. For example, an aerial survey by Nova Scotia Lands and Forests (NSL&F) personnel on 8 June 1979 showed four concentrations of eiders along the outer coast near Green Bay with total numbers approaching 600 birds (mostly males), more than Lock (this publication) found in early May on the entire coast from Cape Sable to Halifax. Some of those birds evidently remain in the same area all summer, as about 300 were seen at various locations near Port Joli in summer. Another NSL&F aerial survey, on 8 and 11 August 1975, showed about 1700 eiders along the shores of Chignecto Bay, Minas Channel, and Minas Basin. Presumably these included many birds from other breeding areas, perhaps southwestern New Brunswick, as the local breeding stock (100 pairs) could hardly account for more than 400 birds in late summer. Palmer's (1976) description of moult migrations northeastward from Maine could also account for these birds, although we know of no banding evidence in support of such movements.

5. Fall migration of eiders in the Maritimes

5.1. Evidence from recoveries of banded birds □

Recoveries of banded birds connect two points and dates in the life of any given bird, but say little about the routes followed in between. A composite picture can emerge when 50 or more recoveries are available from a given banding area and, although few of the available samples are that large, the patterns shown are consistent with what we know from other sources.

Banded eiders were all caught originally as nesting females, so most later contacts were recaptures or casualties on or near nesting islands, with rather low distant

Table 1
Known breeding sites of Common Eiders in New Brunswick
Sites connus de nidification de l'Eider à duvet au Nouveau-Brunswick

Location *Endroit*	No. of pairs or nests[a] *N^bre de couples ou nids*[a]	Type of count *Type d'inventaire*	Year of count *Année de l'inventaire*	Observer or source *Référence*
Bay of Chaleur				
Fleming Is. off New Mills	95	UC[b]	1974	MNRS[d] (Lebel, Madden *et al.*, Smith *et al.*)
Is. off Benjamin River	16	UC	1975	MNRS (Madden *et al.*, Smith *et al.*)
Heron Island	brood only (perhaps from above) *couvée seulement (peut-être du groupe précédent)*	—	1970	MNRS (Madden *et al.*)
Fundy shore				
Manawagonish Island	25	PCIE[c]	1979	CWS[e] (Lock, unpubl.)
Brothers Islands (=Salkeld or Saco)	72	UC	1976	MNRS (Barkhouse *et al.*)
New River Island	7	UC	1972	MNRS (Deichmann)
Holts Point, Bocabec Bay	brood only *couvée seulement*	—	1968	MNRS (J. S. Erskine)
Campobello – Head Harbour Passage				
White Horse Islet	22	UC	1979	CWS (Lock, unpubl.)
Hospital Island	8	UC	1979	CWS (Lock, unpubl.)
Tinker Islet	5	PCIE	1979	CWS (Lock, unpubl.)
Green Island	4	UC	1979	CWS (Lock, unpubl.)
The Wolves	1000+	PCIE	1983	CWS (Hicklin, unpubl.)
Grand Manan				
Low Duck Island	1+	UC	1978	MNRS (Dalzell)
Pumpkin Islet	5	UC	1979	CWS (Lock, unpubl.)
Green Islands	140	PCIE	1979	CWS (Lock, unpubl.)
Three Islands (Kent, Hay, Sheep)	1300	PCIE	1972	Bowdoin Coll. field station (per A. Lock)
Western Green Island	46	UC	1979	CWS (Lock, unpubl.)
West Pumpkin Island	6	UC	1979	CWS (Lock, unpubl.)

[a] Most recent figure, or highest (when several recent counts).
[b] Unadjusted ground count.
[c] Partial count, intuitive extrapolation.
[d] Maritimes Nest Record Scheme.
[e] Canadian Wildlife Service.

[a] *Résultat le plus récent ou le plus élevé lorsqu'il y a plusieurs décomptes récents.*
[b] *Dénombrement au sol (non ajusté).*
[c] *Dénombrement partiel, extrapolation intuitive.*
[d] *Fichier de nidification pour les Maritimes.*
[e] *Service canadien de la faune.*

Table 2
Known breeding sites of Common Eiders in Nova Scotia
Sites connus de nidification de l'Eider à duvet en Nouvelle-Écosse

Location *Endroit*	No. of pairs or nests[a] *N^{bres} de couples ou nids[a]*	Type of count *Type d'inventaire*	Observation year *Année de l'inventaire*	Observer or source *Référence*
Minas Basin				
Five Islands	10	PCIE[b]	1976	MNRS[c] (Barkhouse and Barrow)
Brothers Islands	9	PCIE	1976	MNRS (Barkhouse and Barrow)
Spencers Island	50	PCIE	1980	MNRS (Malone)
Isle Haute	broods only *couvées seulement*	—	1980	P.C. Smith (pers. commun.)
Southwestern Nova Scotia				
Cape Forchu	brood only *couvée seulement*	—	1980	NSBS[d] (Allen)
Chebogue Point	brood only *couvée seulement*	—	1980	NSBS (Allen)
Mud Island	125	PCIE	1974	NSL&F[e] survey (F. Payne *et al.*)
Round Island	20	UC[f]	1940	N. Cunningham (per B.J. Smith)
Noddy Island	nesting *nidification*	—	—	C. Jones (per B.J. Smith)
Seal Island	200	PCIE	1980	C. Jones (per B.J. Smith)
Goodwin Island	3–4	UC	recently	N. Kendrick (per B.J. Smith)
Bon Portage Island	5–6 broods only *5 à 6 couvées seulement*	—	1974–75	N. Kendrick (per B.J. Smith)
Green Island	1–2	UC	1980	N. Cunningham (per B.J. Smith)
South shore				
Ram Island	1	UC	1976	MNRS (Barkhouse and Barrow)
Indian Island off La Have	2–3 nests *2 à 3 nids*	UC	late 1970s	pers. commun. (Ken Greg)
Big Duck Island off Lunenburg	2	UC	late 1970s	pers. commun. (Ken Greg)
Little Duck Island	3	UC	late 1970s	pers. commun. (Ken Greg)
Eastern Shore (listed from west to east)				
Barren Island	28	UC, FF[g]	1971	MNRS (Lock)
Duck Island off Owl's Head	10	PCIE	1971	MNRS (Lock)
Outer Island near Tangier	5	UC	1971	MNRS (Lock)
Ironbond Island near Tangier	abundant *abondant*	RF[h]	1971	MNRS (Lock)
Tangier Island	abundant *abondant*	RF	1971	MNRS (Lock)
Horse Island off Mushaboom	25	PCIE	1971	MNRS (Ross)
Is. S of Mink Island	3	UC	1971	MNRS (Lock)
Round Island	4	UC	1971	MNRS (Lock)
N of Sutherland Island	5	FF	1971	MNRS (Lock)
Pumpkin Island	1	UC	1971	MNRS (Lock)
Is. W of Brother Islands	15	PCIE	1971	MNRS (Lock)
Horse Island	15	PCIE	1971	MNRS (Lock)
Off Quoddy	20 broods *20 couvées*	—	1962	MNRS (Dicks)
Harbour Islands	160	PCIE	1978	NSL&F survey (Austin-Smith, Barkhouse *et al.*)
Long Island	164	UC	1978	NSL&F survey (Austin-Smith, Barkhouse *et al.*)
Bird Islands	176	UC	1977	NSL&F survey (Austin-Smith, Barkhouse *et al.*)
Brokenback Island	180	UC	1971	MNRS (McAloney)
Gold Island	24	UC	1977	NSL&F survey (Austin-Smith, Barkhouse *et al.*)

(cont'd)

Table 2 (cont'd)
Known breeding sites of Common Eiders in Nova Scotia
Sites connus de nidification de l'Eider à duvet en Nouvelle-Écosse

Location *Endroit*	No. of pairs or nests[a] *N^bre de couples ou nids[a]*	Type of count *Type d'inventaire*	Observation year *Année de l'inventaire*	Observer or source *Référence*
MacDonald Island	5	UC	1971	MNRS (Lock)
Halibut Island	420	PCIE	1978	NSL&F survey (Austin-Smith, Barkhouse *et al.*)
Is. S of Orkney Island	51	UC	1977	NSL&F survey (Austin-Smith, Barkhouse *et al.*)
Camp Island	9	UC	1977	NSL&F survey (Austin-Smith, Barkhouse *et al.*)
White Island	360 +	UC	1977	NSL&F survey (Austin-Smith, Barkhouse *et al.*)
Little White Island	183	UC	1977	NSL&F survey (Austin-Smith, Barkhouse *et al.*)
Tobacco Island	698	UC	1978	Harris (1979)
Wedge Island	20	UC	1971	MNRS (Sabean)
Walter Island	17	UC	1971	MNRS (McAloney)
Bickerton Island	1	UC	1970	MNRS (McAloney)
Goose Island	100	PCIE	1971	MNRS (Lock)
Is. NE of Coddle Island	4	UC	1971	MNRS (Lock)
Is. E of Coddle Island	2	UC	1971	MNRS (Lock)
Sugar Islands	173	UC	1980	MNRS (McAloney)
Tanner Island	3	UC	1975	MNRS (McAloney)
Is. SW of Port Felix	1	UC	1971	MNRS (Lock)
Is. off Whitehaven	15	PCIE	1971	MNRS (Lock)
Doliver Island	12	UC	1975	MNRS (McAloney)
Millstone Island	16	UC	1975	MNRS (McAloney)
Southern Cape Breton Island				
Red Island	1	UC	1971	MNRS (Lock)
Basque Islands	45	UC	1975	MNRS (Banks)

[a] Most recent figure, or highest (when several recent counts).
[b] Partial count, intuitive extrapolation.
[c] Maritimes Nest Records Scheme.
[d] Nova Scotia Bird Society.
[e] Department of Lands and Forests, Nova Scotia.
[f] Unadjusted ground count (may be relatively complete or casual observation.)
[g] Count of females flushed from island.
[h] Reported by fishermen.

[a] *Résultat le plus récent ou le plus élevé lorsqu'il y a plusieurs décomptes récents.*
[b] *Dénombrement partiel, extrapolation intuitive.*
[c] *Fichier de nidification pour les Maritimes.*
[d] *Nova Scotia Bird Society.*
[e] *Ministère des Terres et Forêts, Nouvelle-Écosse.*
[f] *Dénombrement au sol non ajusté (relativement complet ou observation occasionnelle).*
[g] *Décompte des femelles levées des îles.*
[h] *Rapporté par des pêcheurs.*

recoveries. Nearly all the recovered birds were shot in fall, in their home province or in Maine or Massachusetts. Almost two-thirds of the recoveries (41 of 63) of Nova-Scotia-banded eiders occurred in that province, mostly in Shelburne County at the southern tip, principally in October through November (31 recoveries) and December through January (6). Only 3 of 19 recoveries of New-Brunswick-banded birds were in that province and occurred in November and December. Evidence of movements between provinces was limited to one October recovery near Cape Sable, Nova Scotia, of a New-Brunswick-banded eider. All other recoveries of birds from both provinces of origin occurred in Maine (21 recoveries, chiefly in October–December) and in Massachusetts (16, mainly in November–January). The later recoveries in Massachusetts may reflect only later dates for the sea-duck hunting season there. Eiders can be hunted legally in various parts of the Maritimes in January and February but the bulk of sea-duck hunting takes place in fall, so the relative scarcity of winter recoveries there does not necessarily indicate that most birds move to Massachusetts to winter, though some evidently do so.

In support of that pattern, six recoveries of eiders (of assorted age and sex classes) banded in December–March in Massachusetts occurred in southwestern Nova Scotia (4) and southwestern New Brunswick (2). One of the Nova Scotia recoveries was in September (illegal), and two others were undated and possibly also illegal (one was reported during May). The others were in October, December, and February, so no clear pattern of movement is shown other than confirming that the eiders wintering in Massachusetts come in part through the Maritimes.

On the other hand, 13 recoveries of eiders banded as flightless young in Maine were from southwestern Nova Scotia, none east of Liverpool (three in October, five in November, three in December, one in January). Fall movements across the Gulf of Maine thus are not all in a westward direction, and such dispersal helps to explain the recolonization of Maritimes breeding areas subsequent to 1920.

The eiders that breed along the St. Lawrence estuary are another stock that occurs in the Maritimes (Reed 1975). The 29 recoveries in the Maritimes, all of adult females originally caught on nests, show a movement down the northeast coast of New Brunswick from October through November. Recoveries near Midgic, New Brunswick, and Windsor, Nova Scotia, in late October and early November suggest overland migration to the Bay of Fundy (see section 5.2), but a recovery in the

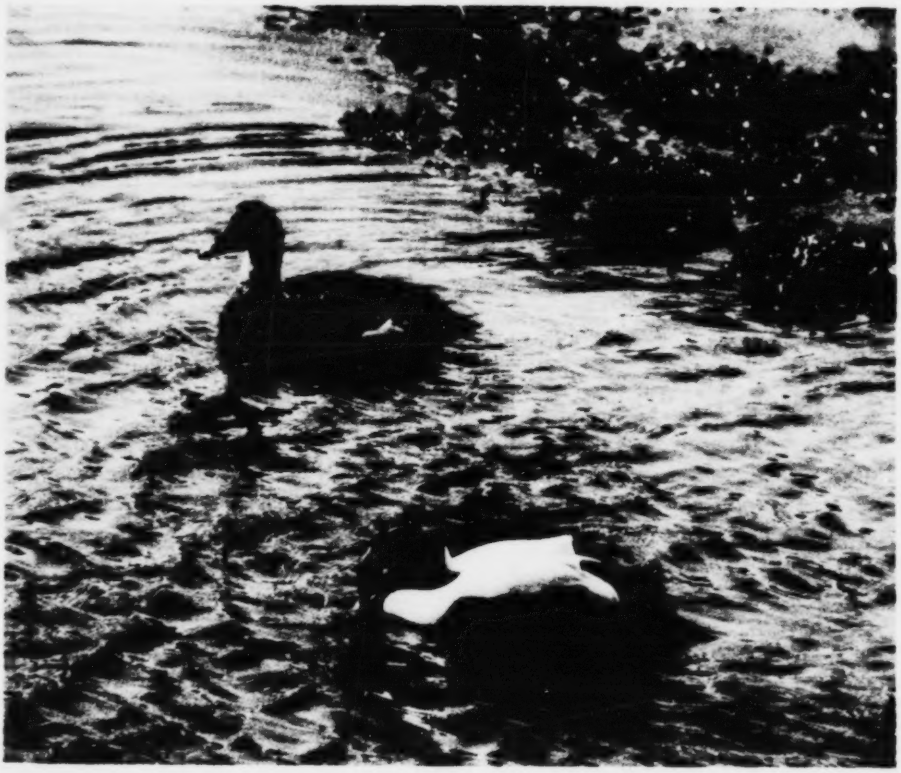
Table 3
Estimates of eider duck breeding populations in New Brunswick and Nova Scotia
Estimations des populations nicheuses d'Eider à duvet au Nouveau-Brunswick et en Nouvelle-Écosse

Area *Région*	Number known breeding sites[a] *N^bre connu de sites de nidification*[a]	Number of estimated breeding pairs in known sites[b] *N^bre estimé de couples nicheurs dans les sites connus*[b]	Est. total numbers of pairs[c] *N^bre total estimé de couples nicheurs*[c]
New Brunswick			
Bay of Chaleur	3	112	150
Fundy shore	4	105	2000
Deer Island – Head Harbour – Campobello Island	4	39	800
The Wolves	1	1000	1350
Grand Manan	6	1498	2750
Total			7050
Nova Scotia			
Upper Bay of Fundy	4	71	100
Southwestern Nova Scotia	9	360	1050
South shore	4	9	400
Eastern Shore	37	2740	6300
South Cape Breton	2	46	250
Total			8100

[a] Closely associated island clusters considered as one site.
[b] Total of known sites, unadjusted for sites not surveyed.
[c] Adjusted for sites not surveyed, rounded to nearest 50.

[a] *Un groupement serré d'îles est considéré comme un site.*
[b] *Total pour des sites connus, non ajusté pour des sites non inventoriés.*
[c] *Ajusté pour des sites non inventoriés, arrondi au 50 près.*

Pair of Common Eiders
Couple d'Eiders à duvet
(photo: A. Reed)



same period from the eastern mainland of Nova Scotia indicates that other birds follow the coast round to the Strait of Canso, as already remarked by Reed (1975). Recoveries on the Atlantic coast of Nova Scotia were mostly later, with none west of Halifax until December, which suggests use of Canso Strait rather than the overland route. January recoveries were on the outer coasts of Nova Scotia (6), southwestern New Brunswick (1), and northeast New Brunswick (2). Two (illegal) spring recoveries in northeast New Brunswick were in late April and early May.

Finally, two adult female eiders trapped on nests in southern Labrador were recovered in southwestern Nova Scotia in late October and early November, and a third in Maine during December. Labrador eiders thus also contribute to the October passage through the Maritimes, but two of these three recoveries suggest a movement through the Bay of Fundy rather than along the outer coasts of Nova Scotia. Further discussion will be deferred until the other evidence has been presented.

5.2. Evidence from "visible migration"

"Visible migration," refers to observations of eiders in flight in contexts where migration rather than local movements can be inferred. Our largest body of such information came from Reid McManus, a naturalist who has lived all his life at Memramcook, a few kilometres north upriver from the head of the Bay of Fundy (Fig. 2). For many years he has seen eider flocks passing northwards in spring and southwards in fall, crossing the Chignecto Isthmus by overland flights of some 40 km; his notes for 1964–76 were available for our analysis.

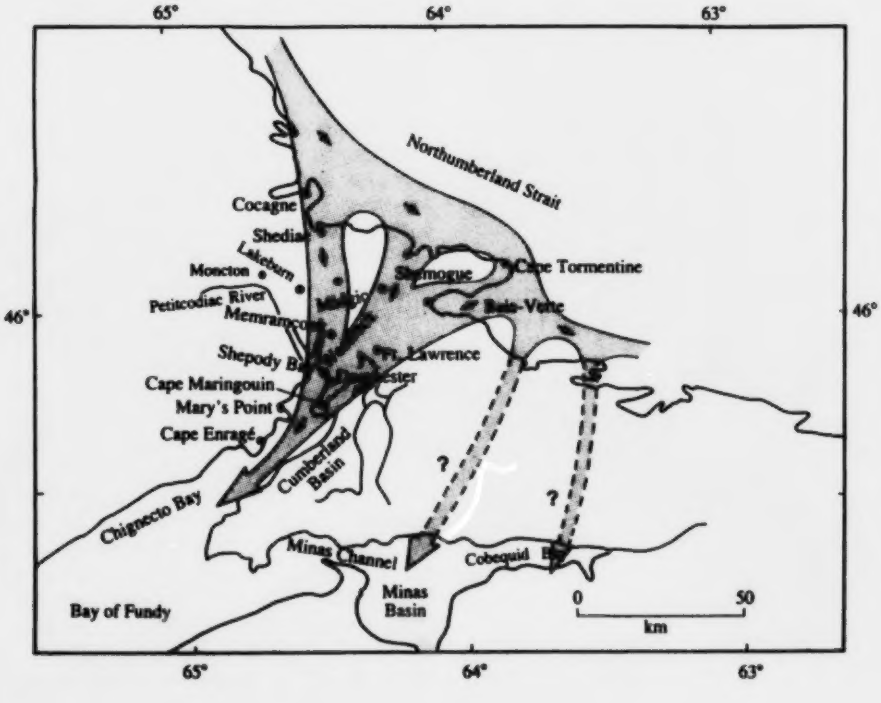
Observations at Memramcook were much less frequent in fall than in spring. Probably this reflects partly that the fall migration across the isthmus occurs on a broader front, whereas in spring the movement is progressively narrowed, from the Bay of Fundy to Chignecto and Shepody Bays to the Memramcook and Petitcodiac River valleys. Visible evidence of the broad front movement in fall, additional to McManus' records, included 100 birds flying southwest a few kilometres from Shediac, New Brunswick, 21 October 1972 (Moncton Naturalists Club); 200 flying south near Dorchester, New Brunswick, 2 October 1970 (D. S. Christie); 300 flying south near Westcock, New Brunswick (A. J. Erskine) and 27 flying southwest at Fort Lawrence, Nova Scotia on 6 November 1977; (S. I. Tingley), 30 flying southwest from Baie Verte, New Brunswick, 4 October 1966 (A. J. Erskine); and 12 flocks passing southwest over Tintamarre National Wildlife Area near Midgic, New Brunswick, on 1–9 October 1973 (CWS files) (Fig. 2). McManus had records of southward migration in fall on 22 dates in eight different years, all between 25 September and 7 December except for 75 birds on 25 December 1969. The interquartile range, by dates, extended from 8 October through 11 November, when an estimated 2475 birds passed, compared to 610 earlier and 885 later, so the mean flock size was evidently larger during the main passage. Stated flight directions were all to the southwest (11 dates), south (nine dates), or southeast (one date). Migration occurred as often with head winds as with following winds. Comparison with mean frequencies of wind direction (data from the Moncton, New Brunswick, weather station, about 15 km northwest) showed that migration occurred slightly more often than normal with southerly winds, but much less often with winds from west to southwest, the most prevalent direction in the area. Most sightings were made in late afternoon or evening, but this probably reflected the times of day the observer was afield rather than any preference by the birds.

Like many marine birds, eiders are reluctant to fly over land. The flock heading inland from Baie Verte, New Brunswick, on 4 October 1966 climbed steeply to perhaps 300 m, from which height they may have been able to see across the isthmus to Cumberland Basin before crossing the shoreline (Gauthier *et al.* 1976). On 13 October 1966, another flock flew down the Strait of Canso to the Canso Causeway, which extends across the strait but with maximum height and breadth of only about 15 m (including utility poles) and 30 m, respectively. On approaching the causeway, the eiders turned aside and followed it all the way across to the other side of the strait (1.5 km). On finding no gap, they circled upwards, and only after gaining at least 100 m altitude did they continue southeast across the causeway.

Tufts (1962) stated that overland flights of eiders pass southwesterly from Minas Basin during October; that direction seems improbable, but a southward flight of 60 km would bring them to Mahone Bay. The one recovery on the Minas Basin of an eider banded in Quebec shows that some birds do reach that landlocked bay from the north, and they may continue overland to the south.

Eiders have also been seen heading across the Gulf of Maine towards Massachusetts, with several hundred passing in 15 min at Cape Sable, Nova Scotia, 30 September 1979, and 75 heading west at Seal Island (near Cape Sable Island), Nova Scotia, 21 October 1973 (*Nova Scotia Bird Society Newsletter* (NSBSN).

Figure 2
Chignecto Isthmus, showing overland routes used by eiders migrating from Northumberland Strait to Bay of Fundy in fall
L'Isthme de Chignecto montrant des routes de migration empruntées par des eiders entre le détroit de Northumberland et la baie de Fundy à l'automne



5.3. Evidence from aerial and ground surveys □

Since 1965, CWS biologists have conducted many surveys of coastal waters around the Maritimes, particularly to pinpoint waterfowl concentration areas for use in assessing environmental impacts of developments or oil spills in particular areas. Coverage was sporadic, depending on available funding and specific needs, and eiders were rarely sought out specifically.

The earliest fall records dated from mid-September, with over 650 eiders seen along the shores of Cobequid Bay 17 September 1974. The October records showed few concentrations except in southwestern New Brunswick, where over 5000 were seen on 17 October 1972. Most October sightings were along Northumberland Strait from Cocagne to Shemogue, but single-day counts there were all less than 300 birds; there was no evidence of any appreciable stopover before migration continued eastwards or across the isthmus. November sightings in eastern New Brunswick involved slightly larger numbers, with up to 350 birds at Kouchibouguac Lagoon (in the national park) and off Cape Jourimain near Cape Tourmentine, but the highest counts on this coast were in early December, especially off Point Escuminac (2257 on 2 December 1975, 1490 on 1 December 1978). Presumably those represented the final exodus of eiders forced out of the St. Lawrence estuary by winter conditions although many eiders remain in the north part of the Gulf of St. Lawrence in winter (Bourget *et al.*, this publication).

Observations along the Atlantic coasts of Nova Scotia included late summer concentrations in areas where no breeding is known such as the outer coast near Port Joli (e.g., 6 September 1975, 700 at Cadden Bay; 27 August 1976, 2000 at Port l'Hébert). Presumably these precede the more typical migration, which at Cape Sable started between 17 and 27 September in 1974–79. Migration peaks, when reported, generally occurred in October: e.g., along the outer coast near Green Bay (thousands off Broad Cove in 1972), near Port Joli (1200 off Hemeon Head on 5 October 1978), and off Cape Sable (5000, mid-October 1975) (NSBSN). The banding recoveries suggested that the early October movement along the Nova Scotia coast represented mainly the Eastern Shore stock; some Labrador eiders reach southern Nova Scotia by the end of October, but the Quebec birds move later and many of them cross to the Bay of Fundy. The southwestern Nova Scotia and southwestern New Brunswick stocks may remain all year in the breeding areas, or they may join the eiders that winter in Maine and especially Massachusetts (Bellrose 1976).

6. Wintering of eiders in the Maritimes

Eiders winter regularly in open waters around the Maritimes, but there has never been evidence to suggest really large concentrations such as those off Massachusetts (Griscom and Snyder 1955), the northeastern Gulf of St. Lawrence (Bourget *et al.*, this publication), or Newfoundland (Gillespie and Learning 1974). The period when birds are relatively sedentary in winter extends only from mid-December to mid-February, and in some years there may be withdrawals from more northern areas, in response to ice conditions, into early January.

The CWS aerial surveys, although very sporadic for some areas, give the most extensive coverage available. Mid-December and January surveys showed fewer eiders around Grand Manan and elsewhere in southwestern New Brunswick than earlier on, with total numbers usually under 1000 birds and in some cold years in the early 1960s as low as 100 birds. In that period, numbers in St. Mary's Bay, Nova Scotia, increased to over 1000 (1918 on 1 December 1974, 1121 on 26 January 1974), but no large concentrations were detected elsewhere around southwestern Nova Scotia (e.g., 404 around Cape Sable Island on 13 January 1976). In the very open winter of 1979–80, numbers wintering off northeastern New Brunswick were higher than usual (Tabusintac to Shippegan, 516 on 30 January 1980); that shore is more often largely icebound from December to April. Early February concentrations averaged larger, but showed no important shifts in location. Counts from Grand Manan to Maces Bay in southwestern New Brunswick ranged from 2070 to 2400 eiders, and the St. Mary's Bay area had 1450 to 2360 birds. Numbers in extreme southern Nova Scotia showed some eastward shifting, with totals of 1200 and 1550 birds, including 825 near Port Joli (15 February 1974) and 770 at the southern entrance to Mahone Bay (4 February 1975). By late February movements were clearly underway.

The picture from scattered ground surveys agreed in general with that from aerial observations, although larger counts were made in some areas from the ground. Estimates for the Cape Sable Island area were 1400 in 1978–79 and 750 the following winter, with 100–250 in the Green Bay area which represents the eastern limit of winter range excluding a few small groups.

Most surveys have concentrated on nearshore waters, and many eiders around offshore islands were doubtless missed, but the total number of eiders wintering in the Maritimes seems unlikely to exceed 10 000 birds. The vast majority are in the southwest, with only scattered small flocks east of Saint John, New Brunswick, and Liverpool, Nova Scotia, respectively.

7. Spring migration of eiders in the Maritimes

7.1. Evidence from aerial and ground surveys

As already noted, movement away from wintering areas is already underway by late February. Aerial surveys 23–24 February 1977 showed over 3600 eiders from Liverpool east to Halifax, and nearly 1700 from within the Eastern Shore breeding areas. At the same period, numbers from Grand Manan to Maces Bay approached 3000 birds, which numbers were maintained through March, when the St. Mary's Bay area showed similar concentrations. Ground observers seldom recognized eider migration earlier than mid-March, but few made extensive surveys during February. Eiders had returned to Minas Basin by 12 March 1978 (100) and 27 March 1976, and to Cape Tormentine, New Brunswick, by 24 March 1979.

April clearly covered the bulk of the migration, as almost all areas had their highest counts then. At the head of the Bay of Fundy, numbers at the mouths of the Petitcodiac and Memramcook Rivers in 1969–76 ranged from 100 up to nearly 800, and along the east coast of New Brunswick aerial surveys showed over 2300 by 6 April 1967 and nearly 4800 on 16 April 1975. The Grand Manan to Maces Bay breeding area held over 6000 eiders 26 April 1972, approaching the breeding population. The St. Mary's Bay, Nova Scotia, area still had over 1300 birds 2 April 1975, nearly as many as were found that day from there round to Port Joli. By far the largest aerial count covered the entire Eastern Shore from Halifax to Canso, where nearly 12 000 eiders were counted, on 11 April 1975; these probably represented the local breeding population for the most part. Ground surveys also showed peak counts during April; e.g., near Cape Enrage, New Brunswick, 5000+ on 24 April 1973; Green Bay, Nova Scotia, 1000 on 18 April 1976; Lawrencetown (east of Halifax), 2500 on 8 April 1979, all outside of breeding areas.

By May, numbers had fallen to summer levels away from breeding areas, although an aerial survey on 1 May 1975 still showed more than 3200 between Halifax and Mahone Bay. In 1975 also, ground observers noted 1300 eiders at Green Bay as late as 3 May. Those were evidently late migrants, as they moved away in the next 2 weeks. More typical non-breeding groups included 500 around Brier Island on 11 May 1979, and 150 at St. Mary's Bay on 19 May 1960; eiders summer in those areas, but suitable nesting islands are lacking.

7.2. Evidence from visible migration

In spring, observations show one movement narrowly channelled along the New Brunswick shore of the Bay of Fundy, and thence northwards overland. At Cape Enrage, H. Deichmann (pers. commun.) provided records of visible migration of eiders for nine dates between 28 March and 9 May in 1974–78, mostly in relatively small flocks (20–60 birds) but often adding up to over 100 birds per hour. About 15 km farther northeast at Mary's Point, CWS staff sighted migrating eiders on four dates from 7 April to 25 May in 1972–76. Another 40 km farther north, E. Price saw 3000–4000 eiders passing northwards over Lakeburn, in flocks of 200–600 birds, 5–8 April 1965 (*Nature News*). McManus also saw mostly flocks of more than 100 birds at Memramcook; although the larger flocks would be more visible and easily detected by ground observers, it seems likely that some coalescence of flocks takes place before the overland migration. Boyer (1966) stated that eiders also fly northeast across the isthmus from Cumberland Basin in spring, but gave specific records only for 1949 (10, 20, and 27 April) and 1955 (16 June); this is evidently much less regular than the Shepody Bay route, and no one else has noted such a movement, despite increased recent field-work.

McManus' Memramcook records for spring totalled 90 dates and 117 separate flocks, in 11 years. The span of extreme dates was from 15 February to 27 June, with one earlier and one later date of uncertain significance. The interquartile range, by dates, was 26 March–23 April, with 11 185 birds in that period compared to 3894 earlier and 3275 later, again with larger flocks during the migration peak. Flight directions stated, excluding four headed to west, southwest, and southeast, were as follows: N 33, NNE 2, NE 59, ENE 2, E 7; all such flocks would reach the sea within 35 km. Wind directions at the times of sightings were predominantly southerly, so in contrast to fall migration most northerly flights across the isthmus were made with following winds. Such winds occurred on migration days far more frequently than in the mean distribution of directions, whereas migration occurred relatively less often with westerly or northerly winds than the mean occurrence of such winds. As in fall, sightings were predominantly in late afternoon or evening, although relatively more visible migration was seen in the forenoon in spring than in fall.

The available data suggest that upwards of 1000 eiders per day cross the isthmus when conditions are suitable; we have no information as to what proportion of eiders fly too high to be readily seen from the ground, but most sightings are well below the limit of visibility, and records of eiders picked up dead after having struck hydro wires during overland crossings (specimens in CWS collection: one female, Memramcook, April 1970; one male, west of Shediac, 4 June 1967) suggest that most birds fly below 200 m. It seems likely that at least 20 000 eiders make that crossing each spring, and the number could be much larger than this, perhaps including most of the St. Lawrence estuary eiders that do not migrate directly overland (Gauthier *et al.* 1976).

Other casual observations of visible migration, largely gleaned from the *Nova Scotia Bird Society Newsletter*, involved movements eastward along the Atlantic coasts of Nova Scotia; e.g., 4 April 1969, 12 April 1975 (600 in 30 min), both east of Halifax. Less typical was a sighting on 8 April 1966 of 60 eiders flying northeast off Louisbourg, Nova Scotia. That location is 70 km east of any known breeding area in the Maritimes, so those birds presumably were headed for Newfoundland or Labrador.

8. Conclusions and recommendations for further studies

Eiders have not received a high priority for investigations in the Maritimes. They were almost extirpated from the region before the Migratory Birds Convention was signed in 1916, and protection took effect only gradually and — still in places — incompletely. The areas frequented by eiders, whether for breeding or at other seasons, have mostly been remote from population centres and little visited by tourists, so there has been little public pressure in their favour. Sea-duck hunters continued to pursue them, in season and frequently also at other times, but until recently the feeling had been that they were drawing largely on some unidentified but also inexhaustible stock breeding in the far north. The threat of oil spills has been present for many years, but those concerned were merely voices crying in the wilderness (Brown *et al.* 1973, Pearce and Smith 1974), until the *Kurdistan* episode in 1979 temporarily reduced the well-studied eider population on Tobacco Island (Eastern Shore, Nova Scotia) by two-thirds (Harris 1979). The request to contribute to this volume caught us with little summarized information and, initially, little appreciation of the relative importance of the Maritimes to Common Eider populations of the Atlantic seaboard. Drawing together the material presented here has focused our attention on the obvious gaps in our knowledge of breeding distribution, and also on the methods available for population monitoring in the aftermath of oil spill disasters. We knew already that eiders from outside the region contributed to the sea-duck harvest, but the idea that three distinct stocks from other areas as well as three from within the Maritimes were involved was a surprise. We had not appreciated the importance of the Northumberland Strait to (and from) Chignecto Bay overland crossing.

We suggest that the following studies relating to eiders in the Maritimes should be implemented during the next 5 years:

1. comprehensive ground-based surveys to more accurately estimate the numbers and distribution of breeding eiders in the three main stocks within the Maritimes;
2. systematic aerial surveys overlapping in time with parts of the ground surveys, to provide air-to-ground adjustment factors that would allow for rapid reassessment of populations from the air following oil spills;
3. where possible, additional banding would be desirable, particularly for the southwestern New Brunswick and southwestern Nova Scotia stocks, for which we lack clear evidence of movements;
4. systematic counts of eider migration in the New Brunswick – Nova Scotia border and Canso Strait areas would be desirable, to better assess the rates of passage over the spring and fall seasons; and
5. examination of samples of hunter-killed birds at intervals through the season would provide data on the occurrence and timing of *borealis* eiders, which can be clearly identified as coming from Labrador or farther north. This will involve increased coordination between CWS biological and enforcement staff as well as with provincial personnel.

In 1966, one of us (A.J. Erskine), with R.W. Fyfe, suggested that the lack of data on movements and harvest of sea ducks might be the most pressing task for future waterfowl research and surveys in the Maritimes. The information gap is still there, but this paper should help to define the scope of the problem, at least for eiders.

9. Acknowledgments

In preparing this report, we have made use of data collected by many people for many reasons, and we cannot name here all individuals we would like to thank. We thank the provincial wildlife agencies of New Brunswick and Nova Scotia for the use of data, made available through biologists John Baird and Peter Austin-Smith, respectively. A large body of data on breeding areas was drawn from the files of the Maritimes Nest Records Scheme (MNRS), and we thank those who contributed data to that file. Other data not specifically credited are from unpublished data collected by CWS personnel. We also acknowledge the use of data assembled in the pages of *Nature News* (New Brunswick Museum), the *New Brunswick Naturalist* (New Brunswick Federation of Naturalists), and the *Nova Scotia Bird Society Newsletter*. We also appreciate the interest and efforts of Keith McAloney, biologist with Ducks Unlimited Canada, in breeding eider inventories at Tobacco Island, Nova Scotia, and of Betty June Smith for assembling the casual observations of fishermen in the Cape Sable Island area. Finally, we especially thank Reid McManus for the use of his visible migration data from Memramcook; such long-term collection of valuable data by a lone volunteer is an example that is as inspiring as it is rare. This account is thus the fruit of collaboration between federal, provincial, and volunteer observers, and we, the compilers, salute those whose efforts have made it possible. The technical assistance provided by Dale Morton in assembling eider migration and band recovery data for this report was most helpful, and we appreciate his efforts.

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A census of Common Eiders breeding in Labrador and the Maritime Provinces

Évaluation des populations nicheuses d'Eider à duvet du Labrador et des Maritimes

A.R. Lock

1. Abstract

The method of censusing Common Eider (*Somateria mollissima*) breeding populations by aerial counts of the highly visible adult males at breeding season has been successfully employed in Maine and Scandinavia. In neither case was the accuracy of the method tested by collateral nest counts. In Labrador, careful colony censuses on two substantial stretches of coast were carried out to test the accuracy of aerial counts. In the two ground census areas a total of 4864 nests were found, and 5419 adult males were counted in these same areas during an aerial survey; the ratio of adult males per nest was 0.98:1 for the northern area and 1.2:1 for the southern sector, averaging 1.11:1. Discrepancies from the expected 1:1 ratio are ascribed to a dispersal of some males from the censused areas after breeding and to incomplete counts in one of the census areas. An estimated 14 000 – 15 000 pairs of eiders breed on the Labrador coast.

Aerial counts of male eiders at breeding concentrations in Nova Scotia and New Brunswick resulted in breeding population estimates of 8000 and 7000 pairs respectively.

2. Résumé

Les nombres d'Eiders à duvet (*Somateria mollissima*) nichant dans l'état du Maine et dans une partie de la Scandinavie ont été évalués avec succès grâce à des relevés aériens de mâles adultes. Dans ces études, cependant, on n'a pas établi la précision de ces estimations par des dénombrements concomitants de nids. Au Labrador, des dénombrements minutieux de nids le long de deux secteurs importants de la côte ont permis de vérifier la précision des estimations établies par relevés aériens. Dans les deux secteurs, 4864 nids ont été trouvés tandis que 5419 mâles adultes ont été observés du haut des airs dans les mêmes secteurs; le nombre de mâles adultes par nid était de 0,98 dans le secteur nord et de 1,2 dans le secteur sud et une moyenne générale de 1,11. Les différences avec le nombre escompté d'un mâle par nid sont attribuables à la dispersion de quelques mâles après la période de nidification et à un dénombrement incomplet dans un secteur. La population d'Eider à duvet sur la côte du Labrador a ainsi été établie entre 14 000 et 15 000 couples.

Des relevés aériens effectués dans des concentrations en Nouvelle-Écosse et au Nouveau-Brunswick ont révélé des populations de 8000 et 7000 couples, respectivement.

3. ᓄᐃᑎᑕᐅᔪᑦ

ᐱᓇᓱᒍᑎᐅᔪᖅ ᑭᓯᑦᓯᓂᕐᒥᒃ ᒥᑎᕐᓂᒃ ᒪᓐᓂᓕᐅᕐᑐᓂᒃ ᖃᖓᒃᑕᔪᒃᑯᑦ ᑭᓯᓯᓂᐅᓯᒪᔪᑎᒍᑦ ᐊᖑᓴᓪᓗᕐᑎᒍᑦ ᓄᐃᑕᑦᓯᐊᑐᑎᒍᑦ ᒪᓐᓂᓕᐅᕐᓇᓕᕐᑎᓗᒍ ᐱᑦᓯᐊᓯᒪᕗᖅ ᒪᓂ Maine-ᒥ ᐊᒻᒪᓗ Scandinavia ᓄᓇᖏᓐᓂ. ᑕᒃᑯᓇᓂᐅᒐᓗᐊᖅ, ᑕᐃᒪᐃᒐᓗᐊᕐᑎᓗᒍ, ᓇᒻᒪᓯᐊᕐᓂᖓ ᖃᐅᔨᓴᕐᑕᐅᒪᓂᖏᓐᓄᑦ ᐅᓪᓗᖏᑦᑕ ᑭᓯᑕᐅᒪᓂᖏᓐᓄᑦ. ᓛᐸᑐᐊᒥᓕ, ᐱᑦᓯᐊᕋᓱᐊᕐᓱᒍ ᑭᓯᑦᓯᓂᐅᓯᒪᔪᖅ ᐅᑯᓇᓂ ᒪᕐᕉᓂ ᑕᒪᓂ ᓯᓂᖓᓂ ᐱᓇᓱᑦᑕᐅᒪᕗᑦ ᖃᐅᔨᓴᕋᔭᕐᓗᓂ ᓇᒻᒪᓇᕐᓯᓂ ᖃᖓᒃᑕᔪᒃᑯᑦ ᑭᓯᑕᐅᒪᓂᕐᓂᒃ. ᑕᒃᑯᓇᓂ ᒪᕐᕉᓂ ᓄᓇᒃᑯᑦ ᑭᓯᑕᐅᒪᓂᕐᓂ ᑲᑎᑦᓯᒥᑦ 4864 ᐅᓪᓗᐃᑦ ᓇᑉᐸᑕᐅᓐᓂᖁᑦ. ᐊᒻᒪᓗ 5419 ᐊᖑᓴᓪᓗᐃᑦ ᑕᒃᑯᓇᓂᑦᓴᐃᓇᕐᓗ ᑭᓯᑦᓯᓂᐅᓯᒪᔪᒃᑯᑦ ᖃᖓᒃᑕᔪᒃᑯᑦ; ᐊᒥᓱᓂᕆᔭᖏᑦ ᐊᖑᓴᓪᓗᐃᑦ ᐊᑐᓂᑦ ᐊᑐᓂᑦ ᐅᓪᓗᒧᑦ ᐃᒪᐃᑦᑐᓂᖁᖅ 0.98:1 ᒪᑐᒧᖓ ᑕᕐᕋᐅᑉ ᓄᓇᓕᖓᓄᑦ ᐊᒻᒪᓗ 1.2:1 ᓯᕗᓂᖓᓄᑦ. ᒥᑦᓴᓂᒐᑦᓯᓂ 1.11:1 ᐊᕐᖃᑎᒥᒍᑕᐅᓯᒪᖏᓂᕆᔭᖓᒍᑦ ᐅᑯᓇᖓ ᐃᒪᐃᓪᓗᐊᕋᔭᕐᑐᓇᔭᓯᒪᔪᓂᒃ 1:1-ᓂᒃ ᐃᒥᓱᓂᕆᒐᔭᕐᓯᒪᔭᖏᑎᒍᑦ ᑕᐃᔭᐅᓂᖃᑐᑎᒍᑦ ᐅᑯᐊ ᓇᒧᑐᐃᓐᓇᕋᕐᓂᖏᓐᓄᑦ ᐊᖑᓴᓪᓗᐃᑦ ᒪᖓᑦ ᐱᑦᓯᑎᒃ ᑭᓯᑕᐅᒪᐱᐅᓯᒪᔪᓂᒃ ᒪᓐᓂᓕᐅᕆᕐᓯᒪᓕᕐᑎᓗᒥᑦ ᐊᒻᒪᓗ ᐱᔭᕆᕐᓯᒪᖏᑐᑎᒍᑦ ᑭᓯᓯᓂᐅᔪᑎᒍᑦ ᑭᓯᑦᓯᐱᐅᓯᒪᔪᓂᑦ. ᐊᑯᓐᓂᖓᓂ 14,000 ᐊᒻᒪᓗ 15,000 ᐊᖑᓴᓪᓗᒥᑦ ᒪᓐᓂᓕᐅᓂᐊᖑᕆᔭᐅᓯᖑᐳᑦ ᓛᐸᑐᐊᑉ ᓯᓂᖓᓂ ᑭᓯᓯᓂᐅᓯᒪᔪᑦ ᖃᖓᒃᑕᔪᒃᑯᑦ ᒪᑯᓂᖓ ᐊᖑᓴᓪᓗᖏᓐᓂᒃ ᒪᓐᓂᓕᐅᕐᐱᐅᕙᓂ Nova Scotia-ᒥ ᐊᒻᒪᓗ New Brunswick-ᒥ ᓄᐃᒃᑲᐃᓯᒪᕗᑦ ᐃᒪᐃᓪᓗᐊᑐᑲᓚᓂᒃ ᒪᓐᓂᓕᐅᓯᓂ 8,000-ᓂᒃ ᐊᒻᒪᓗ 7,000-ᓂᒃ ᐊᖑᓴᓪᓗᕆᓂᒃ.

4. Introduction

In eastern North America, Common Eiders breed on sea coasts from southern Massachusetts to the Canadian High Arctic. Two subspecies occur on the Atlantic coast: *S. m. borealis* breeds in the northern part of the range and *S. m. dresseri* in the south. The zone of overlap centres on Groswater Bay in Labrador, extending from about 53°N to about 55°30′N (Mendall 1980). Eiders are abundant, and breeding distribution is continuous throughout this range wherever suitable nesting habitat is found, except on the island of Newfoundland where intense human persecution has reduced the breeding population to a few hundred pairs, some nesting on isolated islands in freshwater lakes (R.I. Goudie, pers. commun.).

Substantial breeding concentrations exist in the St. Lawrence estuary, in Labrador, on the Eastern Shore of Nova Scotia and in southwestern New Brunswick. Though eiders breed colonially the difficulties of carrying out accurate nest counts are such that only the St. Lawrence estuary population has been adequately censused (Reed 1973). In Nova Scotia and New Brunswick individual colonies have been censused but no reliable estimates of the sizes of their breeding eider populations have been made. In Labrador the Common Eider is considered "common" or "abundant" but no attempt has been made to assess the size of the breeding population and there are no records of accurate colony censuses. The coast's remoteness, which has attracted many ornithologists during the past 100 years, has hindered systematic or quantitative assessments of the species that breed there.

Aerial counts have been used to assess populations of many species of waterfowl and eider breeding population estimates have been made for Maine and the Baltic Sea using this method (Mendall 1968, Almkvist and Andersson 1972, and Almkvist *et al.* 1975).

Attempts to carry out aerial counts of breeding females are typically confounded by the similarity of immature birds of both sexes to adult females and the inconspicuousness of these essentially "brown" birds. However, in his aerial censuses of eiders breeding in Maine, Mendall (1968) counted all eiders seen and he was able to classify a sufficient number of them that age/sex structure and population size could be reliably deduced. His census was carried out soon after the arrival of birds and before the start of incubation. The Scandinavian workers, in contrast, counted only adult males which gathered in large flocks when females were incubating. The sex ratio was determined by ground observations and an assumption made that each adult male signified one breeding pair.

Figure 1
The coast of Labrador
La côte du Labrador

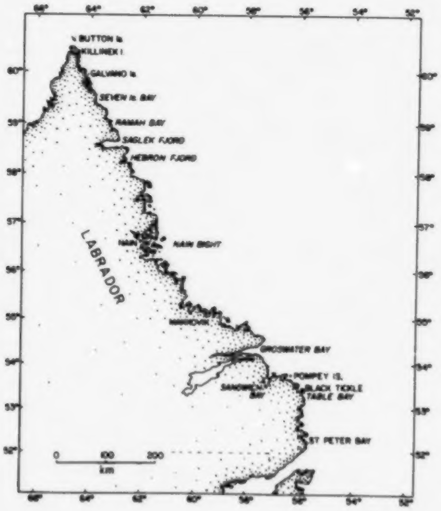
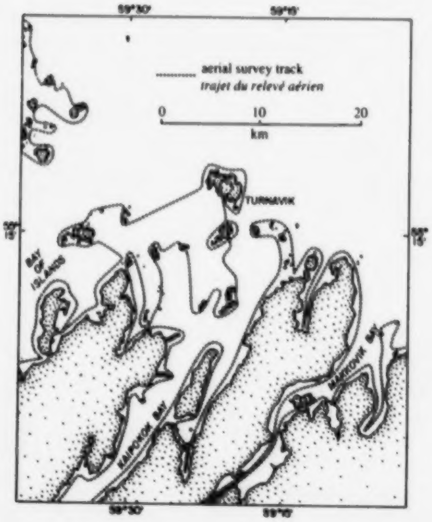


Figure 2
Aerial survey track near Makkovik, Labrador
Trajet du relevé aérien près de Makkovik, Labrador



When the problem of censusing breeding eiders in Labrador was confronted, the difficulties of travel on the coast and the large number of islands prohibited any attempt to census the population by nest counts. The simplest method of assessing the size and distribution of the breeding population would be by aerial counts of adult males shortly after the initiation of clutches. Counts were made between 6 June and 9 July 1980 and it was apparent that, contrary to the European experience, in Labrador males did not gather in large flocks, but dispersed in smaller flocks deeper in the bays and closer inshore. A lack of knowledge of the post-breeding dispersal of Labrador eiders and the observed differences from the northern European pattern prevented any confident assumption that the number of pairs breeding in Labrador equalled the number of males counted.

To estimate the breeding population, it was necessary to determine, for wide areas of the Labrador coast, both the numbers of active nests and the number of adult males present immediately following clutch initiation. It was not possible to carry out aerial surveys and nest counts in the same breeding season. The 1980 aerial survey results, which covered the entire coast, were used to select two substantial portions for ground nest counts in 1981.

Areas for ground censusing were selected by the following criteria:
1. The area should contain a substantial breeding population, preferably greater than 1000 pairs.
2. It should be spatially isolated from other breeding concentrations in order to minimize the likelihood of emigration to or immigration from adjacent areas.
3. It should be of such a size that it could be censused by one field party in a single breeding season.

The section of coast north of 58°N (Fig. 1) appeared to satisfy these criteria, but selection of a second ground census area was more difficult.

Only that part of southern Labrador between Black Tickle and Pompey Island appeared appropriate, but because it was only 70–80 km from the north shore of Groswater Bay where some eiders also breed, it was less satisfactory than the northern study area.

Having found that in Labrador aerial surveys can provide accurate estimates of nesting pairs, I was prompted to conduct aerial surveys of several breeding concentrations in Nova Scotia and New Brunswick in 1982.

5. Methods

Aerial counts were carried out from a Cessna 185 on floats in Labrador and a Lake Amphibian in Nova Scotia and New Brunswick. These aircraft were flown at a height of 75 m and a speed of 160 km/h on a course approximately 120 m offshore. Every bay, fiord, and inlet was examined and the flight line was extended to offshore islands and shoals; Figure 2 shows a typical survey track. The pilot located waterfowl on his side of the survey path and made counts of smaller flocks. I counted all flocks of more than about 20 birds. I recorded the numbers and locations of all waterfowl seen on tape and marked the survey track on 1:250 000 scale topographic maps.

We counted all waterfowl observed and examined areas of waterfowl habitat not immediately on the survey path with 8 × 30 binoculars. We counted individuals in small flocks, and groups of five or ten in larger flocks. The aircraft circled large flocks at a suitable height while we repeated counts of each flock to ensure accuracy. When flocks of eiders were of mixed sex, we counted adult males first. Then the adult females and immatures, which were categorized together as "brown" birds, were either counted, or their number was determined by subtracting the count of adult males from the total count. If little time was available, we counted the adult males first, and derived the number of "brown" birds from an estimate of the ratio of "brown" birds to adult males.

In Labrador, the general course of the survey was from south to north in order that each section of the coast might be censused at roughly the same part of the breeding cycle. Because of the time required to fly the entire coast it was not possible to synchronize the survey exactly with the beginning of incubation. Because an examination of the coast south of 53°N (Fig. 1) and parts of the north shore of Groswater Bay on 6–8 June showed that eiders had barely started to lay eggs, we delayed the start of the survey north of 53°N until 18 June 1980; our count was not completed until 20 July by which time incubation was well underway. Aerial counts on the Atlantic coast of Nova Scotia and in southwestern New Brunswick were made between 18 and 23 May 1982, when most females were beginning incubation.

Two field parties carried out colony censuses in Labrador, each attempting to inspect all islands in its assigned area, and carrying out a careful search for nests. All nesting areas were searched systematically and thoroughly; as nests were discovered each was marked with a piece of green

Table 1
Numbers of waterfowl counted on the June 1980 survey of the Labrador coast
Nombres d'anatidés recensés sur la côte du Labrador, juin 1980

Survey block *Secteur*	Male eiders *Eiders mâles*	"Brown" eiders *Eiders «bruns»*	Surf Scoters *Macreuses à front blanc*	W.-w. Scoters *Macreuses à ailes blanches*	Canada Geese *Bernaches du Canada*	Black Ducks *Canards noirs*	Goldeneye *Garrots spp.*	Mergansers *Becs-scie spp.*	Other *Autres*	Total
51½°–52°N	15	3	978	70	0	135	30	27	20	1 278
52°–52½°N	2 105	1 670	84	212	10	22	62	15	7	4 187
52½°–53°N	46	47	64	77	3	0	65	4	0	306
53°–53½°N	200	141	77	18	6	1	57	10	0	510
53½°–54°N	3 714	3 724	3 847	200	42	173	22	18	0	11 740
54°–54½°N	1 373	746	673	35	42	1087	0	0	44	4 000
54½°–55°N	1 312	1 193	130	12	83	211	93	2	0	3 036
55°–55½°N	938	790	1 844	62	107	80	914	24	0	4 759
55½°–56°N	512	455	1 628	72	114	80	96	30	1	2 988
56°–56½°N	1 650	1 333	7 833	496	28	34	1027	75	0	12 476
56½°–57°N	1 261	1 287	1 844	448	32	75	2204	24	17	7 192
57°–57½°N	279	203	1 476	6021	47	92	414	48	0	8 580
57½°–58°N	58	56	0	0	35	49	421	2	0	621
58°–58½°N	146	95	98	51	0	0	148	19	0	557
58½°–59°N	825	941	1 400	335	37	0	117	8	0	3 663
59°–59½°N	379	899	0	0	26	0	44	8	0	1 356
59½°–60°N	247	462	0	0	11	0	83	8	0	811
60°–60½°N	378	641	0	0	107	0	59	13	0	1 198
60½°–61°N	5	11	0	0	0	1	0	0	0	17
Total	15 443	14 697	21 976	8109	730	2040	5856	335	89	69 275

Table 2
Common Eider colonies in northern Labrador
Colonies d'Eider à duvet, Labrador septentrional

Colony name or description *Nom ou description*	No.	Position Lat.	Long.	Census date *Date du recensement*	No. of nests *Nbre de nids*
Austin Island	1	60°17′	64°22′	6 July	14
Second most northerly of the Duck Islands	2	60°14′	64°21′	6 July	16
U. Is.* NW of Kmock Island	3	60°13′	64°21′	6 July	21
U. Is. N of the Hutton Peninsula	4	60°09′	64°17′	6 July	271
U. Is. N of Tait Point	5	60°04′	64°15′	8 July	226
Mikak Island	6	60°02′	64°12′	8 July	134
Galvano Islands	7	59°57′	63°57′	10 July	64
	8	59°57′	63°57′	10 July	411
	9	59°55′	63°58′	11 July	11
	10	59°55′	63°58′	11 July	99
	11	59°56′	63°58′	11 July	7
	12	59°56′	63°58′	11 July	19
	13	59°56′	63°58′	11 July	50
	14	59°57′	64°00′	11 July	35
	15	59°57′	63°57′	10 July	5
	16	59°57′	63°57′	10 July	17
	17	59°57′	63°57′	12 July	225
U. Is. NE of Kennard Island	18	59°26′	63°40′	15 July	128
One of the Hog Islands	19	59°25′	63°40′	15 July	207
One of the Hog Islands	20	59°25′	63°40′	15 July	3
Southernmost of the Bryant Islands	21	59°22′	63°39′	15 July	27
U. Is. at the mouth of Ramah Bay	22	58°54′	63°12′	19 July	24
Ukkalek	23	58°18′	62°37′	25 June	3
Dog Islands	24	58°12′	62°37′	22 June	4

*Unnamed island. * *Nom de l'île inconnu.*

vegetation to prevent it being recounted. In each area, counts began a week or 10 days after the first eggs were laid and wound up before all had hatched.

Each nest discovered was categorized as active or inactive: those in the former category contained eggs, remains of hatched eggs, or recently hatched ducklings; all other nests were considered inactive.

6. Results

Table 1 summarizes the abundance and distribution of all waterfowl counted on the June 1980 aerial survey of the Labrador coast, and Figure 3 shows the distributions of adult male and "brown" eiders (adult females and immatures of both sexes).

On the approximately 300 km of coastline between the Button Islands and Hebron Fjord, we surveyed all islands presenting suitable nesting habitat and found eiders breeding at 24 sites (Table 2 and Fig. 4). In that area we counted 2021 nests, including 15 recently destroyed nests in colony 2.

In southern Labrador, we found 37 colonies and 2242 nests (Table 3 and Fig. 5). In five of these colonies, nest counts were incomplete, either because insufficient time was available to search out all nests in heavily wooded islands or because, late in the season, down had been blown from some abandoned nest cups making them difficult to find. In these colonies the census crew estimated the total breeding population based on nest numbers and densities in searched portions of the

Figure 3
Numbers of adult male and "brown" Common Eiders counted on the June 1980 aerial survey of Labrador
Eiders à duvet mâles adultes et «bruns» dénombrés lors d'un relevé aérien au Labrador en juin 1980

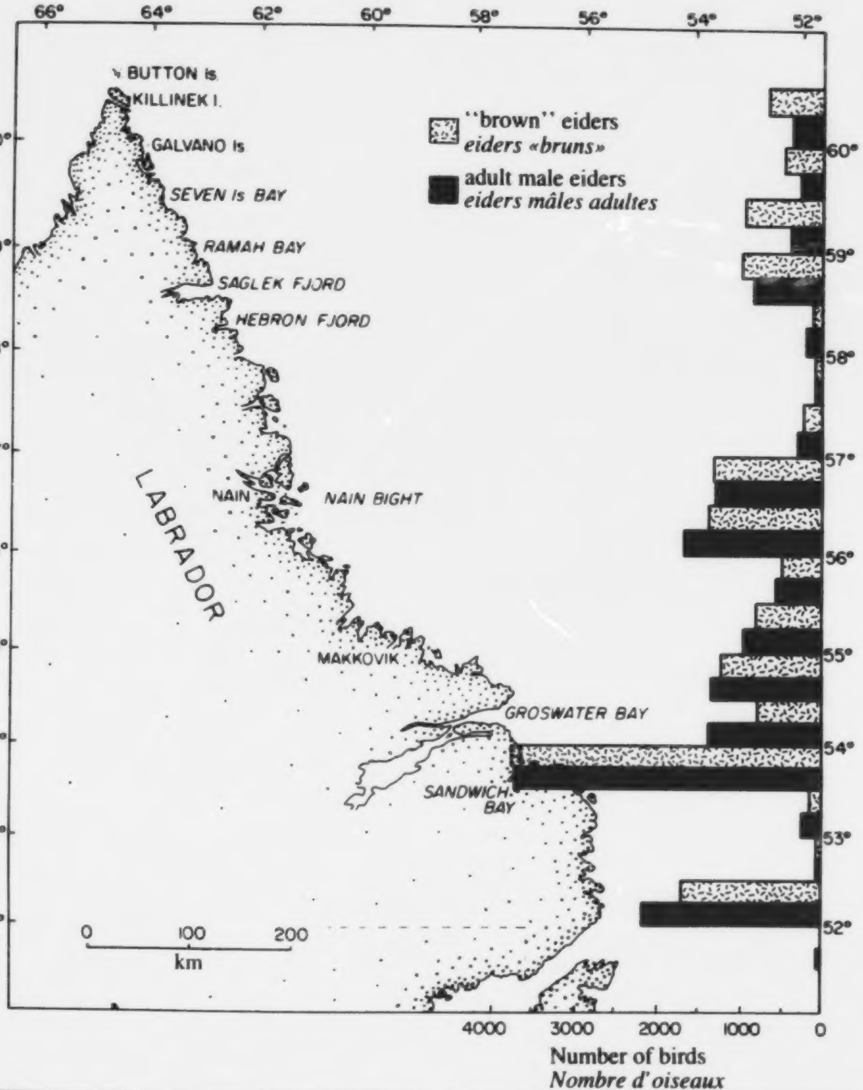
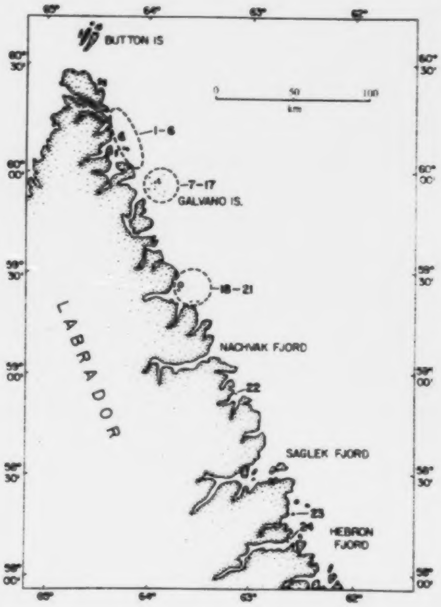


Figure 4
Colonies of Common Eiders in northern Labrador.
Numerals correspond to Table 2
Colonies d'Eider à duvet au Labrador septentrional.
Les chiffres correspondent au tableau 2



colonies. Where such estimates were made, Table 3 shows actual nest counts in brackets and an estimate of the total number of breeding pairs in that colony outside the brackets. In the southern census area two small areas that might have harboured breeding eiders were not searched; these are circled in Figure 5.

Table 4 compares the numbers of pairs of Common Eiders found to be breeding on six segments of the northern coast with the number of adult males counted on aerial and boat counts in the same areas. For the isolated breeding group in northern Labrador the ratio of males counted from the air to nest numbers was 0.98:1; in southern Labrador, 3439 adult males were counted to an estimated 2843 nests: a ratio of 1.21 males per nest.

Tables 5 and 6 summarize the results of the Nova Scotia and New Brunswick aerial surveys. Figures 6 and 7 show the distributions of adult males. Totals of 15 031 adult males and 10 484 "brown" birds were recorded. Figure 6 also shows that the proportion of "brown" birds varied widely: "browns" were proportionately most abundant in areas of low breeding density and least abundant in areas of high breeding density.

7. Discussion

In northern Europe male eiders have been observed to gather in large flocks at the outermost edges of archipelagos after females have started incubating. In Labrador and the Maritime Provinces, males gathered soon after breeding in many smaller, easily counted flocks with varying numbers of "brown" birds. Aerial counts are notoriously unreliable when the sizes of large flocks must be quickly estimated but the numbers of adult male eiders shown in tables 1, 5, and 6 are counts of individuals in relatively small and well-dispersed flocks. Coverage of the surveyed coasts was thorough (Fig. 2) and these estimates are thought to be quite accurate. In both of the Labrador ground census areas the numbers of adult males counted on aerial surveys agree quite well with the numbers of breeding pairs determined by nest counts.

Unfortunately, colony nest counts have not been carried out over any substantial portion of the eider's breeding range in the Maritime Provinces so it is not possible to correlate these aerial counts with accurate ground counts.

In searches of eider colonies some nests inevitably will be missed; Kadlec and Drury (1968) showed that in gull colonies only about 90% of nests were found on a first search. Furthermore, isolated nests and small groups of nests apart from the main colony may occasionally be missed. Nests destroyed by predators shortly before the count, or second nests in which eggs had not been laid, would also remain uncounted. Thus, estimates of numbers of breeding pairs based on a single nest search are conservative. In the northern census area none of the colonies had tree or shrub cover, and counts there are probably more accurate than those done in the

Table 3
Common Eider colonies in southern Labrador
Colonies d'Eider à duvet, Labrador méridional

Colony name or description *Nom ou description*	No.	Position		Census date *Date du recensement*	No. of nests *N^{bre} de nids*
		Lat.	Long.		
Tinker Island	25	53°50′	56°35′	19 June	3
North Sister Island	26	53°48′	56°31′	19 June	4
South Sister Island	27	53°48′	56°31′	19 June	6
Islet at the top of Long Island	28	53°48′	56°37′	19 June	4
Flat Islands	29	53°45′	56°20′	8 July	12
U. Is.* N of Star Island	30	53°42′	56°31′	5 July	3
U. Is. NE of Star Island	31	53°42′	56°30′	5 July	5
Star Island	32	53°41′	56°31′	5 July	1
U. Is. 1 km NW of Ledge Island	33	53°42′	56°33′	6 July	13
U. Is. 2 km E of Suglo Point	34	53°43′	56°34′	6 July	675 (361)†
U. Is. S of Ledge Island	35	53°40′	56°33′	6 July	225 (120)†
U. Is. S of Ledge Island	36	53°40′	56°32′	6 July	26
U. Is. 2 km W of Quakers Hat	37	53°41′	56°23′	27 June	144
U. Is. 2 km W of Quakers Hat	38	53°40′	56°23′	29 June	19
Quakers Hat	39	53°39′	56°21′	25 June	209
Entry Island	40	53°42′	56°23′	29 June	138
U. Is. NW of Collingham Island	41	53°43′	56°18′	30 June	12
U. Is. N of Collingham Island	42	53°43′	56°18′	30 June	107
U. Is. NE of Collingham Island	43	53°43′	56°18′	30 June	55
U. Is. 3 km S of Devils Lookout	44	53°37′	56°18′	28 June	50
U. Is. 2 km E of Cape Greep	45	53°41′	56°09′	20 July	395 (308)†
U. Is. 3 km SE of Cape Greep	46	53°35′	56°09′	20 July	370 (295)†
Eastmost of the Ferret Islands	47	53°41′	55°54′	19 July	40 (20)†
Deer Island	48	53°34′	55°55′	20 July	11
U. Is. 2 km SW of Deer Island	49	53°33′	55°56′	19 July	5
U. Is. 5 km W of White Island	50	53°32′	55°58′	18 July	49
White Island	51	53°32′	55°33′	18 July	6
U. Is. 1 km SW of White Island	52	53°32′	55°54′	18 July	3
Duck Island	53	53°31′	55°32′	14 July	1
U. Is. 3 km W of Eagle Island	54	53°28′	56°03′	18 July	98
U. Is. N of Eagle Island	55	53°29′	55°59′	14 July	34
U. Is. N of Eagle Island	56	53°29′	55°59′	14 July	11
Eagle Island	57	53°28′	56°02′	18 July	4
U. Is. S of Eagle Island	58	53°28′	55°59′	17 July	17
U. Is. 3 km S of Eagle Island	59	53°27′	55°59′	18 July	20
U. Is. 3 km S of Eagle Island	60	53°27′	56°00′	18 July	43
U. Is. in Porcupine Bay	61	53°26′	55°59′	17 July	25

* Unnamed island.
† Incomplete nest count: the number in brackets represents the number of nests actually counted, and the other an estimate of total number.

* *Nom de l'île inconnu.*
† *Dénombrement incomplet: le chiffre entre parenthèses représente le nombre de nids recensés, et l'autre une estimation du nombre total.*

south. In the southern census area two island groups that may have had breeding eiders were not searched (Fig. 5). Had it been possible to census the southern area completely, the numbers of males and nests would likely have been closer.

All the eider colonies in northern Labrador and most in southern Labrador were on open, grassy islands with few trees or shrubs. In Nova Scotia and New Brunswick most colonies were on islands with substantial woody cover. I observed in the courses of both the Labrador and Maritimes aerial surveys that significant numbers of males attended females at nests on colonies with open cover. Pettingill (1959) and Munro (1961) noted males attending incubating females as late as 2 weeks into incubation; McKinney (1961), Milne (1963), and Hilden (1964) noted this attendance ceased when the eggs were laid. Sabean (1972), working on Tobacco Island, Eastern Shore, Nova Scotia, noted that in the first year of his study males attended females as late as 20 days into incubation, in the following year males did not attend females during incubation.

I have observed that male attendance on incubating females is most frequent and prolonged in open grassy colonies and relatively infrequent and short in colonies with heavy cover. On the few open colonies, attendant males were visible and readily counted and flushed from the nesting area during aerial counts. On colonies with heavy cover, males were readily counted basking on rocks at the sea edge but were not seen flushing from dense cover, even after repeated low passes of the aircraft. Consequently, though some males may have been invisible to the aerial censuser and the estimate of the breeding population may be correspondingly low, I do not think this constitutes a substantial error.

In northern Labrador, the colony censusers kept a running count of the number of adult male eiders. These counts, totalled over half degrees of latitude, are presented in Table 4 along with numbers of active nests and aerial counts of adult males. Although the overall totals of breeding pairs and of adult males seen were close, there was little agreement between counts of adult males and breeding pairs on small segments of coast. The totals of males counted from the water and from the air were comparable, but the distributions among the six census blocks were less similar. The boat counts revealed that in both years the greatest number occurred in the same block (58°30′N to 59°N), but this was largely attributable to a notable eider concentration near the north shore of Saglek Fjord where no eiders breed. In 1980 this area was censused on

Table 4
Numbers of active nests of Common Eiders on six segments of the northern Labrador coast compared with the numbers of adult males counted on aerial and boat surveys
Nombres de nids actifs d'Eider à duvet dans six secteurs de la côte du Labrador septentrional, et nombres de mâles adultes recensés lors de relevés aériens et en bateau

Latitude	No of active nests *Nbre de nids actifs*	Number of adult males / *Nbre de mâles adultes* 1980 aerial count *Relevé aérien, 1980*	 1981 boat count *Relevé en bateau, 1981*
60°30′ – 61° N	0	5	15
60° – 60°30′ N	682	378	124
59°30′ – 60° N	943	247	69
59° – 59°30′ N	365	379	105
58°30′ – 59° N	24	825	1626
58° – 58°30′ N	7	146	109
Total	2021	1980	2048

Figure 5
Common Eider colonies near Table Bay, southern Labrador. Numerals correspond to Table 3
Colonies d'Eider à duvet au Labrador méridional. Les chiffres correspondent au tableau 3

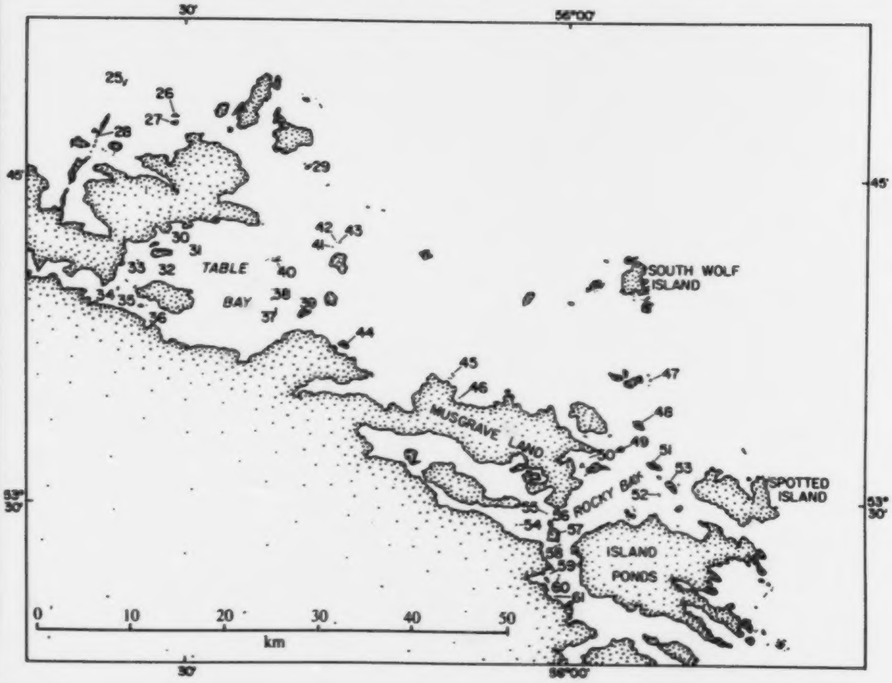

30′
56°00′
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
TABLE
BAY
SOUTH WOLF ISLAND
MUSGRAVE LAND
ROCKY BAY
SPOTTED ISLAND
ISLAND PONDS
45′
53° 30′
0
10
20
30
40
50
km

Figure 6
Numbers of adult male Common Eiders counted in Nova Scotia and, in parentheses, the ratio of adult male to "brown" birds, 1982
Eiders à duvet mâles adultes dénombrés et, entre parenthèses, les rapports mâles adultes et eiders «bruns» selon un relevé en Nouvelle-Écosse en 1982

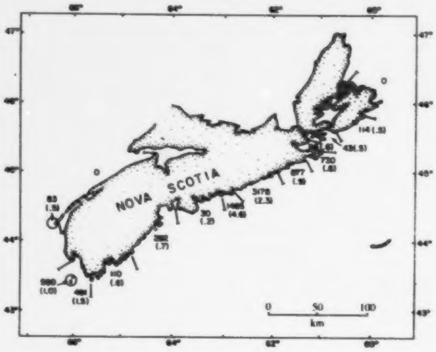
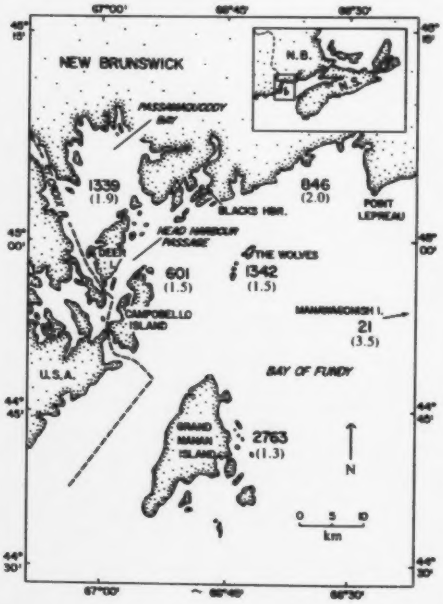

NOVA SCOTIA
3178
(2.3)
730
0
50
100
km

Figure 7
Numbers of adult male Common Eiders counted in southwestern New Brunswick and, in parentheses, the ratio of adult male to "brown" birds, 1982
Eiders à duvet mâles adultes dénombrés et, entre parenthèses, les rapports mâles adultes et eiders «bruns» selon un relevé au Nouveau-Brunswick en 1982


67°00′
66°45′
66°30′
45° 15′
45° 00′
44° 45′
44° 30′
NEW BRUNSWICK
N.B.
N.S.
PASSAMAQUODDY BAY
1339
(1.9)
846
(2.0)
BLACKS HBR.
POINT LEPREAU
HEAD HARBOUR PASSAGE
DEER
THE WOLVES
601
(1.5)
1342
(1.5)
CAMPOBELLO ISLAND
MANAWAGONISH I.
21
(3.5)
U.S.A.
BAY OF FUNDY
GRAND MANAN ISLAND
2763
(1.3)
N
0
5
10
km

8 July but in 1981 not until 21 July when numbers were much greater. The different distributions presumably reflect a progressive movement of males to Saglek Fjord during summer, perhaps a moult migration to sheltered waters with abundant food (Salomonsen 1968).

In Labrador, where numbers of adult males and "brown" birds counted were approximately equal, the ratio of adult males to "brown" birds was lowest in the extreme south but varied with no discernible pattern elsewhere. In Nova Scotia and, less obviously, in New Brunswick the proportion of "brown" birds tended to vary in inverse proportion to the density of breeding birds (Tables 5 and 6, Figs. 6 and 7). That relationship was most apparent on the Eastern Shore of Nova Scotia, between Halifax and Canso. The density of "brown" birds was fairly constant along this stretch of shore and the large variations in the ratios of adult males to "brown" birds was due to the presence of concentrations of breeding males. There is no evidence of immatures being attracted to or excluded from breeding areas.

Carefully executed aerial counts of adult males may allow an adequate estimate of the breeding population of Common Eiders if carried out at the correct time and if the censused area is not too small. The 15 443 adult males counted on the 1980 aerial survey may be taken as a good estimate of the number of pairs breeding on the coast, though the presence of some 1500 birds in St. Peter Bay (52°03′N) on 8 June may detract from the exactness of the estimate. At the most a few hundred pairs breed there, and most of the birds seen there probably bred elsewhere. Subtracting the 1505 males counted in St. Peter Bay from the total, yields an estimate of approximately 14 000 nesting pairs of Common Eiders for the Labrador coast. The concentration of breeding eiders in the Groswater Bay and Nain Bight regions parallels the breeding distribution of alcids in Labrador. Over 95% of the murres (*Uria aalge*, *U. lomvia*), puffins (*Fratercula arctica*), and Razorbills (*Alca torda*) of the Labrador coast also breed in those areas (Lock, unpubl.). Studies on food abundance and feeding biology of seabirds and eiders in that area would undoubtedly help to explain those concentrations.

A total of 15 031 adult males were counted in the censused areas of Nova Scotia and New Brunswick, with 10 484 "brown" birds; equivalent to about 15 000 breeding pairs. Very few eiders breed outside the censused areas (Erskine and Smith, this publication), certainly no more than 500 pairs. A similar number are believed to breed in insular Newfoundland (R.I. Goudie, pers. commun.). Thus the breeding population of Common Eiders in the Atlantic Provinces of Canada can be assumed to be almost 30 000 pairs.

No previous censuses of the Labrador-breeding Common Eider population have been done nor have records of earlier colony nest counts been published so there is little more than anecdotal evidence to suggest the nature of population changes in historic times. A single series of seabird counts made in 1906 may be compared with another series made in the same area under similar conditions 73 years later. Townsend and Allen (1907) travelled from Blanc Sablon (Quebec) to Nain (56°32′N) and back on coastal steamers in July 1906. Between 18 and 24 July they returned from Rigolet (54°11′N) to Nain and they stated that "except when we were eating or sleeping we were always on deck either on the bridge or in the bow, making note of all the birds, seen, using constantly strong binoculars (*sic*)..." In their account of *Birds of Labrador* they tabulated approximate numbers of birds seen on different parts of the cruise. Between 6 and 13 July 1979, seabird counts were made from the coastal boat "Bonavista" on a return trip between Rigolet and Nain (MacLaren Marex 1980). On this trip 101 standard PIROP (Programme Intégré de Recherches sur les Oiseaux Pélagiques,

Table 5

Numbers of Common Eiders counted during the Nova Scotia aerial census, 1982

Nombres d'Eiders à duvet recensés lors d'un relevé aérien en Nouvelle-Écosse, 1982

Census block *Secteur*	No. of adult males *Nbre de mâles adultes*	No. of "brown" birds *Nbre d'oiseaux «bruns»*	Ratio of adult males to "brown" birds *Rapport, mâles adultes et oiseaux «bruns»*
Cape Breton Island			
Sydney – Guyon Island	0	0	
Guyon Island – Point Michaud	114	224	0.51
Point Michaud – Eddy Point	43	90	0.48
	157	314	0.50
Eastern Shore			
Eddy Point – Cranberry Island	116	202	0.57
Cranberry Island – Berry Head	730	897	0.81
Berry Head – Cape St. Mary	877	954	0.92
Cape St. Mary – Sheet Harbour	3178	1403	2.27
Sheet Harbour – Jeddore Rock	1485	324	4.58
Jeddore Rock – Halifax	30	150	0.20
	6416	3930	1.63
South shore			
Halifax – Port Joli Head	282	421	0.67
Port Joli Head – Cape Sable	110	197	0.56
Cape Sable – Chebogue Harbour	491	337	1.46
Chebogue Harbour – Long Island	0	0	
Seal Island group	580	564	1.03
Brier Island	83	158	0.53
Brier Island – Cape Split	0	0	
	1546	1677	0.92
Grand total	8119	5921	1.37

Table 6

Numbers of Common Eiders counted on the southwest New Brunswick aerial census, 1982

Nombres d'Eiders à duvet recensés lors d'un relevé aérien au sud-ouest du Nouveau-Brunswick, 1982

Census block *Secteur*	No. of adult males *Nbre de mâles adultes*	No. of "brown" birds *Nbre d'oiseaux «bruns»*	Ratio of adult males to "brown" birds *Rapport, mâles adultes et oiseaux «bruns»*
Grand Manan Island group	2763	2150	1.29
The Wolves	1342	883	1.52
Passamaquoddy Bay and St. Croix River	1339	697	1.92
Campobello Island and Head Harbour Passage – Blacks Harbour	601	402	1.50
Blacks Harbour – Point Lepreau	846	425	1.99
Manawagonish Island	21	6	3.50
Total	6912	4563	1.51

Aerial view of the Labrador coast between Davis Inlet and Nain
Vue aérienne de la côte du Labrador entre Davis Inlet et Nain
(photo: A.R. Lock)

Brown *et al.* 1975) counts of 10 min each were made, covering approximately 340 km of the ship's course.

In order to make constructive comparisons between these two series of observations, they must be standardized in some way, as by comparing them to counts of a species which was equally abundant at the time of both censuses. The only species of seabird thought likely not to have changed much in numbers between the two surveys is the Black Guillemot (*Cepphus grylle*). It has not benefited from human activities nor is there evidence of a decline in numbers. As a widely dispersed breeder it is likely to be fairly sampled by boat observers, unlike species that gather in large flocks or breed in a few large colonies. Townsend and Allen counted an average of only 0.134 eiders for each Black Guillemot whereas the MacLaren Marex observers counted 0.624 eiders per guillemot: an increase of 4.7 times. Obviously the validity of this comparison depends on many assumptions: that numbers of Black Guillemots had not changed in the intervening years, that the ships' courses were sufficiently similar, and that both censuses fairly sampled both eider and guillemot populations. The assumption of an unchanged Black Guillemot population is supported by the calculation that to have counted 673 Black Guillemots, Townsend and Allen must have counted birds over about 800 km of the ship's course. The return trip was approximately 1500 km, so this is not an unreasonable assumption.

The difference between the counts is sufficiently great that it most likely does indicate a real increase in the breeding eider population of Labrador. The apparent changes in numbers of other species of marine birds counted by both censuses and compared by this procedure are all reasonable on the assumption of a general increase in species that formerly were hunted or egged on the Labrador coast.[1]

The decrease in persecution and increase in numbers of marine birds in Labrador has resulted partly from a reduced need for wild food in summer as a result of imports of fresh food to the coast. More important is the change in fishing practices in the Labrador near-shore waters; until recent decades the cod fishery was prosecuted from schooners and many small summer fishing stations on coastal islands which relied on eider and alcid colonies for supplies of eggs and meat. Most fish are now taken by larger offshore trawlers and long-liners, and marine bird colonies are no longer so heavily exploited.

In the northeastern United States and in the Maritime Provinces, eider populations also had been drastically reduced by the beginning of the 20th century, and since that time have made a dramatic recovery (Mendall 1968). This is in strong contrast to the situation in Greenland (Salomonsen 1967) where populations were healthy until late in the last century but have since been gradually declining. Apparently the Labrador eider population had not been so drastically reduced in the early years of this century as the poulations to the south of it, nor has its growth in this century been so dramatic.

8. Acknowledgments

In the field work on which this report is based I was most ably assisted by Gay Hansen, who supervised the Groswater Bay work and by Steven Young, Paul Linegar, and David Mitchell. I am grateful to Petro-Canada for funding the Labrador aerial census and for providing transportation to and from Saglek and accommodations at their Goose Bay, Saglek, and Cartwright camps.

The success of the aerial censuses was due, in great part, to the observing skills, knowledge, and enthusiasm of my two pilots, Clyde House in Labrador and Jim Bickle in Nova Scotia and New Brunswick.

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[1] Now geese and ducks and nameless numbers more,
In social flocks are found on every shore
Their eggs we seek, we rove from Isle to Isle,
Eager to find, and bear away the spoil:
These in abundance every hand picks up,
And when our toil is over, on these we sup.

G. Cartwright (1792)
Labrador: A Poetical Epistle

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Population d'Eider à duvet près des côtes du Québec septentrional

The Common Eider population of the northern Quebec coast

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A. Bourget
W.B. Kemp
D.J. Nakashima
D.J. Murray

1. Résumé

Un relevé aérien effectué en 1978 et des inventaires au sol réalisés en 1980 ont permis d'estimer la population d'Eider à duvet de la baie d'Ungava et des côtes québécoises du détroit d'Hudson (*Somateria mollissima borealis*) à 48 700 couples et celle de la côte est de la baie d'Hudson (*S. m. sedentaria*) à 20 800. De plus, 864 nids (*S. m. borealis*) furent trouvés sur des îlots situés sur des lacs d'eau douce à environ 2,5 km à l'intérieur de la côte de la baie d'Ungava. Dans les îles côtières, le nombre moyen d'oeufs par nid était de 3,57 et la ponte a été initiée vers le 5 juin. Plus de 94 % des nids étaient construits à l'abri d'une structure rocailleuse naturelle et 67 % reposaient sur un substrat de lichens et de mousses. Nous discutons de la précision des estimations et formulons des recommandations quant aux inventaires et études à venir.

2. Abstract

An aerial survey in 1978 and ground inventories in 1980 established the Common Eider population of Ungava Bay and the Quebec coasts of Hudson Strait (*Somateria mollissima borealis*) at approximately 48 700 pairs and that of the east coast of Hudson Bay (*S. m. sedentaria*) at 20 800. An additional 864 nests (*S. m. borealis*) were found on islets in freshwater lakes about 2.5 km inland from Ungava Bay. The main clutch size on coastal islands was 3.57 eggs and the first eggs were laid about 5 June. More than 94% of the nests were built next to natural rocky structures and 67% were on substrates of mosses and lichens. The precision of the estimates is discussed and recommendations made regarding future surveys and research.

3. ᓄᐃᑎᑕᐅᔪᖅ

ᖃᖓᑕᔫᒃᑯᑦ ᖃᐅᔨᓴᓯᐊᕐᓂᐅᓯᒪᔪᖅ 1978-ᒥ ᐊᒻᒪᓗ ᓄᓇᒥ ᑭᓯᑦᓯᓂᐅᓯᒪᔪᖅ 1980-ᒥ ᓄᐃᑦᓯᓯᒪᕗᖅ ᒥᑏ ᖃᑦᓯᐅᓂᖏᓐᓂᒃ ᐅᖓᐸᒥ ᐊᒻᒪᓗ ᑯᐸᐃᒃ ᓯᓈᓂ ᖃᑦᓴᓐᓯᑐᓈᒥ ᓱᒪᑎᐅᔨᐊ ᒧᓕᓯᒪ ᐳᕆᐃᓕᔅ ᑕᐃᒫᒃ ᐊᑎᖏᑦ ᒥᑏᑦ ᐃᒪᐃᓐᓄᐊᑑᒥᐊᖏᑦ 48 700 ᒪᕐᕉᓕᖑᑦᓯᑎᒃ ᐊᒻᒪᓗ ᓯᕿᓂᖑᓂ ᓯᓈᓂ ᖃᑦᓴᓐᐸᐃᑦ (ᓱᒪᑎᐅᔨᐊ ᒧᓕᓯᒪ ᓯᑕᓐᑎᐅᔨᐊ) ᑕᐃᒫᒃ ᐊᑎᖏᑦ ᒥᑏᑦ ᐃᒪᐃᓐᓄᐊᑑᓐᒥᔪᑦ 20 800. ᓱᓕᒥᐊᓐᓚᖅ 864 ᐅᓐᓄᐃᑦ ᓱᒪᑎᐅᔨᐊ ᒧᓕᓯᒪ ᐳᕆᐃᓕᔅ ᓇᑉᐹᑕᐅᓯᒪᒻᒥᔪᑦ ᓄᓇᒥ ᐃᒪᑐᐃᓐᓇᒥ ᑕᓯᖏᓐᓂ ᖃᓐᓂᖏᓂᓕᒻᒥ 2.5 km ᑭᓗᒥᑕᓂᒃ ᓄᓇᒥᑦ ᐅᖓᐸᒥ. ᐱᓗᐊᕐᓂᑉᐹᑦ ᒪᓐᓃᑦ ᐊᖏᓂᖏᑦ ᓯᓈᓂ ᕿᑭᕐᑕᓂ 3.57 ᒪᓐᓃᑦ ᐊᒻᒪᓗ ᒪᓐᓂᓕᐅᓯᓂᖏᑦ ᐱᒋᐊᔾᔪᑦ ᒥᑦᓵᓂ ᔫᓂ 5. 94-ᐳᓴᓐᒥᒃ ᐊᒥᔾᔫᓂᕐᓴᐃᑦ ᐅᓐᓄᐃᑦ ᓴᓇᓯᒪᓐᓂᖁᑦ ᐅᔭᕋᓐᓚᑰᓂ ᐊᒻᒪᓗ 67-ᐳᓴᓐ ᐱᕈᕐᐱᒻᒥᓐᓂᖁᑦ ᓄᓇᔮᓄᑦ ᐊᒻᒪᓗ ᐱᕈᕐᓯᐊᓚᑰᓂ. ᓈᒻᒪᓈᕐᓯᒪᔭᐃᑦ ᑭᓯᑕᐅᒪᓂᖏᑦᑕ ᐅᖄᕐᑕᐅᕗᖅ ᐊᒻᒪᓗ ᐊᑐᐃᓐᓇᐅᑎᑕᐅᕗᖅ ᐱᓐᓄᒍ ᖃᐅᔨᓴᕐᓃᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓴᓯᐊᕐᓃᑦ ᓯᕗᓂᑦᑎᓂ.

4. Introduction

Deux sous-espèces d'Eider à duvet nichent dans les îles côtières du nord du Québec : *Somateria mollissima borealis* dans la baie d'Ungava et le détroit d'Hudson et *S. m. sedentaria* dans la baie d'Hudson. La sous-espèce *S. m. borealis* a déjà été étudiée à Cape Dorset sur la rive nord du détroit d'Hudson (Cooch, 1965). Quant aux populations du sud du détroit et de la baie d'Ungava, elles ont fait l'objet d'observations très fragmentaires (Tener *dans* Bent, 1962; Hildebrand, 1950; Driver, 1958; Todd, 1963). La sous-espèce *S. m. sedentaria* a été étudiée par Freeman (1970) dans les îles Belcher (T.N.-O.), et Manning et Macpherson (1952) et Todd (1963) ont fourni des observations en provenance des îles côtières de l'est de la baie James et de la baie d'Hudson.

À cause de l'importance de l'Eider à duvet dans l'économie et la culture inuit et du nombre de prises de *S. m. borealis* dans les aires d'hivernage (côtes de Terre-Neuve, golfe du Saint-Laurent, voir Wendt et Silieff, présente publication), la communauté inuit du Nouveau-Québec et le Service canadien de la faune (SCF) ont uni leurs efforts pour mieux connaître l'espèce en vue d'un aménagement rationnel de la ressource (Reed, 1982). Le présent article et celui de Nakashima (présente publication) reflètent la somme de ces efforts collectifs.

L'objectif principal du présent travail est de fournir une estimation de la population d'Eider à duvet (*S. m. borealis*) de la baie d'Ungava et du détroit d'Hudson (région côtière adjacente à la province de Québec). C'est à l'aide d'inventaires aériens (Cooch, 1954; Chapdelaine et Tremblay, 1979) et des observations fournies par la communauté inuit du Nord québécois que nous avons sélectionné sept archipels et trois sites à l'intérieur des terres où nous avons réalisé des inventaires au sol entre le 26 juin et le 23 juillet 1980. Les îles inventoriées serviront d'échantillons témoins pour des inventaires de rappel destinés à mesurer les changements qui pourraient intervenir au sein de la population. Nous avons aussi présenté une série d'observations concernant certains aspects de la nidification dans le but de mieux comprendre l'écologie de cette sous-espèce.

Après la réalisation de ce premier objectif, nous avons convenu d'estimer approximativement la population de *S. m. sedentaria* nichant en bordure des côtes québécoises de la baie d'Hudson. Étant donné que nous n'avons pas effectué d'inventaires au sol dans cette région, nous avons utilisé l'inventaire aérien de 1978 (Chapdelaine et Tremblay, 1979) qui couvre à la fois la côte est de la baie d'Hudson, le détroit d'Hudson (côte de la province de Québec) et de la baie d'Ungava. En établissant un rapport entre l'inventaire aérien et au sol de la baie d'Ungava, nous avons obtenu un facteur de conversion utilisable pour transformer en nombre de couples le nombre de mâles observés dans la baie d'Hudson d'après l'inventaire aérien de 1978. Néanmoins, il faut considérer cette estimation comme étant très approximative.

5. Région à l'étude

La figure 1 localise les archipels inventoriés au sol sur les côtes ouest et est de la baie d'Ungava. Sur les cartes topographiques conventionnelles, les archipels A, B, C et D de la figure 1 sont identifiés comme étant respectivement les îles Eider, Plover, Payne et Gyrfalcon. Étant donné que sur ces cartes les archipels de la côte est ne sont pas désignés par un nom toponymique, nous utiliserons les lettres E, F et G pour les identifier dans le présent article. Le trajet de l'inventaire aérien réalisé en 1978 (Chapdelaine et Tremblay, 1979) est également illustré à la figure 1.

Géologiquement, les îles côtières de la baie d'Ungava font partie de la province de Churchill caractérisée par les granites-gneiss du protozoaire inférieur (Stockwell *et al.*, 1970). L'exposition de ces îles aux vents et à l'action des fortes marées chargées de glaces usant la périphérie des îles confère au paysage une physionomie dénudée et rocailleuse. Une des caractéristiques hydrographiques importantes de la baie d'Ungava est l'amplitude des marées. Dunbar (1958) a mesuré des marées maximums de 14 à 16 m à l'embouchure des rivières Koksoak et aux Feuilles. Il mentionne aussi que le patron hydrodynamique des eaux de la baie est dominé et déterminé par les marées dont l'influence sur la productivité des eaux reste à élucider.

D'un point de vue phytogéographique, la végétation de ces îles est caractérisée par la toundra composée principalement par les saules arctiques (*Salix arctica*), les camarines noires (*Empetrum nigrum*), les laiches (*Carex bigelowii*), les lichens (*Alectoria orchreuleuca*, *A. nigricans*, *Cetraria cuculata*, *C. islandica*) et les mousses (*Dicranum elongatum*, *Polytrichum commune* var. *Yukonense*). Toute la partie côtière de la baie d'Ungava est incluse dans la zone bioclimatique de l'Arctique correspondant à l'isotherme de 10°C pour le mois de juillet (Rousseau, 1974).

La faune qui utilise ces îles est surtout composée d'éléments aviens. Outre l'Eider à duvet qui représente l'espèce la plus fréquemment observée sur ces îles, nous avons relevé des mentions de nidification pour les espèces suivantes : Huard à gorge rousse (*Gavia stellata*), Bernache du Canada (*Branta canadensis*), Canard kakawi (*Clangula hyemalis*), Bec-scie à poitrine rousse (*Mergus serrator*), Buse pattue (*Buteo lagopus*), Faucon pèlerin (*Falco peregrinus*), Goéland bourgmestre (*Larus hyperboreus*), Goéland à manteau noir (*L. marinus*), Goéland argenté (*L. argentatus*), Guillemot noir (*Cepphus grylle*), Pipit commun (*Anthus spinoletta*), Pinson à couronne blanche (*Zonotrichia leucophrys*) et le Bruant des neiges (*Plectrophenax nivalis*).

6. Méthode

Dans les archipels des îles Eider et Gyrfalcon, nous avons sélectionné les îles selon un plan de répartition aléatoire. Toutefois, pour éviter qu'un gradient quelconque de densité (nids/ha) passe inaperçu, nous avons essayé de répartir uniformément le choix des îles en divisant l'archipel en trois groupes d'îles, soit petites (≤ 2 ha), moyennes (2,1 à 10 ha) ou grandes ($\geq 10,1$ ha) et nous avons sélectionné les îles au hasard dans chacun de ces groupes. Les îles des archipels de la côte est ont été sélectionnées selon une répartition uniforme. Les îles des archipels Payne et Plover ont été sélectionnées d'après les mentions de nidification déjà rapportées par la communauté inuit.

Nous avons inventorié systématiquement 44 des 167 îles de l'archipel des îles Eider (A), 20 des 45 îles de l'archipel des îles Plover (B), 15 des 55 îles de l'archipel des îles Payne (C), 92 des 201 îles de l'archipel des îles Gyrfalcon (D), 29 des 249 îles de l'archipel E, 23 des 123 îles de l'archipel F et 25 des 219 îles de l'archipel G.

Les figures 2, 3, 4, 5, 6, 7 et 8 représentent la configuration géographique des archipels visités et identifient les îles couvertes systématiquement par les recenseurs. Les déplacements des recenseurs entre les îles étaient assurés par un hélicoptère Bell 206 et des embarcations à moteur. La figure 9 schématise le déplacement des recenseurs sur les îles pour obtenir un dénombrement systématique des nids. La distance requise entre chacun des recenseurs dépend de la densité des nids alors que le nombre de virées nécessaires pour couvrir une île est fonction de sa superficie, de sa forme et de son relief. D'une façon générale, nous avons maintenu une distance variant de 25 à 50 m entre les recenseurs et la méthode des virées successives était préférée à celle d'une virée unique à cause de la forme élargie de la plupart des îles visitées.

Nous avons calculé la superficie des îles à l'aide d'un appareil à balayage électronique. Pour estimer la population d'un archipel, nous avons utilisé la méthode par simple expansion (Cochran, 1977:157) à l'aide de l'équation suivante :

$$Y = N \times y$$

où Y = estimation du nombre de nids dans l'archipel

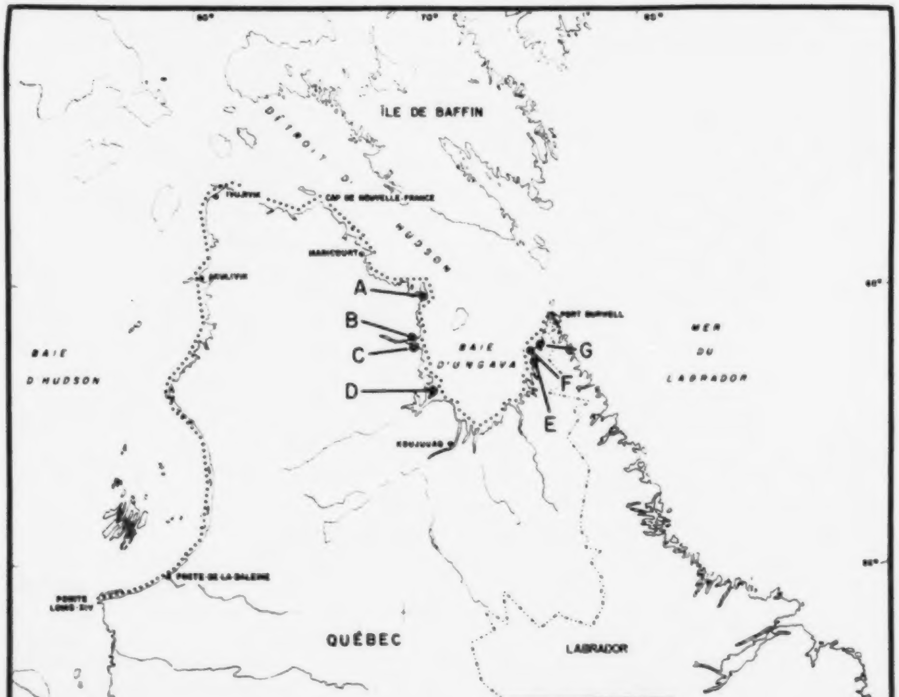
N = nombre d'îles dans l'archipel

y = nombre moyen de nids par île dans l'archipel

Figure 1

Le Nord québécois montrant sept archipels importants pour la nidification de l'Eider à duvet (*A* à *G*) et le trajet d'un relevé aérien effectué en 1978

Northern Quebec showing the location of seven archipelagos important to nesting Common Eiders* (A–G) *and the flight line of an aerial survey conducted in 1978



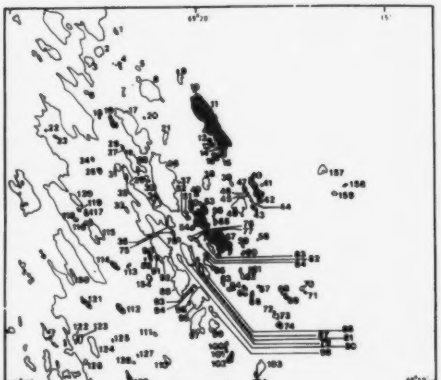
Il est aussi possible d'estimer la population totale d'un archipel en multipliant la densité moyenne des nids par la superficie totale de l'archipel d'après l'équation suggérée par Cochran (1977:151).

$$Y = R \times Z$$

où R = densité moyenne (nids/ha)
Z = superficie totale de l'archipel

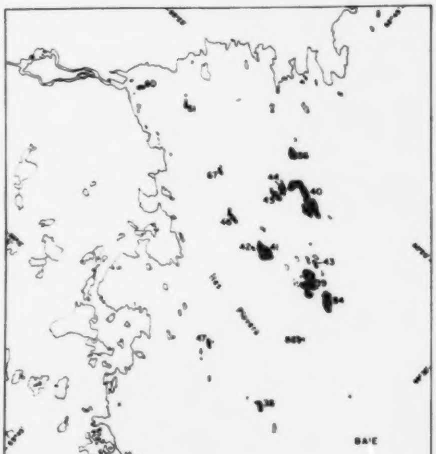
Toutefois, cette méthode fournira de meilleures limites de confiance sur l'estimation plutôt que la méthode par simple expansion si le coefficient de corrélation (nombre de nids en fonction de la superficie) est plus grand que le coefficient de variation des superficies divisé par deux fois le coefficient de variation du nombre de nids (Cochran, 1977:157), c'est-à-dire $r > CVx/CVy$ et que les coefficients de variation (CVx, CVy) ne dépassent pas 10 % (Cochran, 1977:153). En d'autres termes, il faut qu'il existe une relation linéaire entre les variables x et y et que la variance de y soit proportionnelle à celle de x. Nous avons donc calculé ces paramètres statistiques (tableau 1) pour chacun des archipels. Étant donné que dans tous les cas $r < CVx/CVy$ et que les coefficients de variation sont nettement supérieurs à 10 %, il sera donc préférable d'utiliser la méthode par simple expansion pour obtenir des limites de confiance suffisamment étroites pour nos estimations. Mais pour calculer les limites de confiance de l'estimation, les données doivent suivre une distribution normale. Or, pour les sept archipels, la principale déviation à la normalité est caractérisée par une dissymétrie positive, c'est-à-dire que le coefficient de dissymétrie $G_1 > 0$ (tableau 3). Cochran (1977) signale qu'il n'y a pas de règle bien précise pour déterminer la taille de l'échantillon (n) pouvant justifier l'emploi de l'approximation normale dans le calcul des limites de confiance de l'estimation. Pour les populations dont la principale déviation à la normalité est une dissymétrie positive, il suggère que $n > 25G_1^2$. Nous avons donc respecté cette règle pour justifier le calcul des limites de confiance de l'estimation totale de la population de la baie d'Ungava. Toutefois, selon cette règle, nous ne pouvons pas fournir les limites de confiance de l'estimation des populations respectives des sept archipels étant donné que dans tous les cas $n < 25\ G_1^2$.

Figure 2
Archipel des îles Eider
The Eider Islands



■ dénombrements systématiques des nids d'Eider à duvet
complete counts of Common Eider nests

Figure 3
Archipel des îles Plover
The Plover Islands



■ dénombrements systématiques des nids d'Eider à duvet
complete counts of Common Eider nests

En plus des paramètres reliés à l'estimation des populations, nous avons recueilli des informations concernant la biologie de la nidification. Nous avons déterminé le nombre d'oeufs par nid et défini le statut des nids selon que les oeufs étaient en couvaison, en éclosion, éclos ou détruits. Cette information permet aux recenseurs de connaître le stade de la nidification et de savoir si la date à laquelle les inventaires sont effectués correspond à la période où un nombre maximal de femelles ont débuté la ponte. Nous avons aussi amassé des informations sur les microhabitats et les types de substrat utilisés par l'Eider à duvet pour construire son nid.

7. Résultats

7.1. *Somateria mollissima borealis*

7.1.1. Population des îles côtières □

Le tableau 2 résume les dénombrements systématiques des nids pour chacune des îles visitées. Nous avons dénombré systématiquement 4814 nids dont 22,4 % dans les îles Eider, 12,5 % dans les îles Plover, 10,9 % dans les îles Payne, 34,4 % dans les îles Gyrfalcon, 6,5 % dans l'archipel E, 6,4 % dans l'archipel F et 6,9 % dans l'archipel G. Dans les îles Eider, 89 % des îles visitées abritaient au moins un nid, 87 % dans les îles Gyrfalcon, 69 % dans l'archipel E, 44 % dans l'archipel F et 48 % dans l'archipel G. Pour l'archipel des îles Plover et Payne, une telle comparaison n'est pas valable, car le choix des îles visitées a été effectué en fonction de la présence d'eiders au lieu d'une sélection au hasard. Au tableau 3, nous présentons les estimations des populations pour chacun des archipels. Pour l'ensemble des sept archipels, nous avons estimé la population à 18 425 nids. Les archipels des îles Eider et Gyrfalcon représentent les deux principales concentrations d'eiders de la baie d'Ungava avec des estimations respectives de 4095 et 3618 nids. Les estimations pour les cinq autres archipels sont inférieures à 3000 nids.

La densité moyenne (nids/ha) était 2,29 (0,78–225,6) dans les îles Eider, 5,9 (0,22–125,8) dans les îles Plover, 8,1 (0,63–74,9) dans les îles Payne, 5,83 (0,10–301,9) dans les îles Gyrfalcon, 1,11 (0,07–61,8) dans l'archipel E, 1,57 (0,23–3,75) dans l'archipel F et 1,24 (0,03–18,1) dans l'archipel G. Les îles de la côte ouest de la baie d'Ungava apparaissent plus densément peuplées que celles de la côte est.

Au tableau 4, nous avons estimé la population d'Eider à duvet de la baie d'Ungava et d'une partie du détroit d'Hudson (Cap de Nouvelle-France à Port Burwell). Étant donné qu'il n'y a pas d'île entre Ivujivik et le Cap de Nouvelle-France, que la côte est très escarpée et que Cooch (1954) et Chapdelaine et Tremblay (1979) n'ont pas observé d'eiders dans ce secteur, nous considérons que l'Eider à duvet n'y niche pas. Pour estimer la population totale comprise entre le Cap de Nouvelle-France et Port Burwell, nous avons utilisé les critères suivants pour considérer une île comme étant potentiellement habitée par l'Eider à duvet : (1) dénombrement de toutes les îles dont la dimension varie entre 0,5 et 45 ha, ce qui représente les dimensions minimales et maximales des îles visitées en 1980; et (2) nous avons soustrait de ce nombre les îles qui, à marée basse, sont reliées à la terre ferme. Ainsi, nous avons dénombré 2813 îles potentiellement habitables par l'eider. Nous avons obtenu une moyenne de nids par île pour l'ensemble de la baie d'Ungava à partir du regroupement des îles visitées dans les archipels des îles Eider, des îles Gyrfalcon, E, F et G. Nous estimons la population totale de la portion côtière de la baie d'Ungava (Cap de Nouvelle-France à Port Burwell) à 48 667 nids ± 21 % en 1980.

7.1.2. Population à l'intérieur des terres □

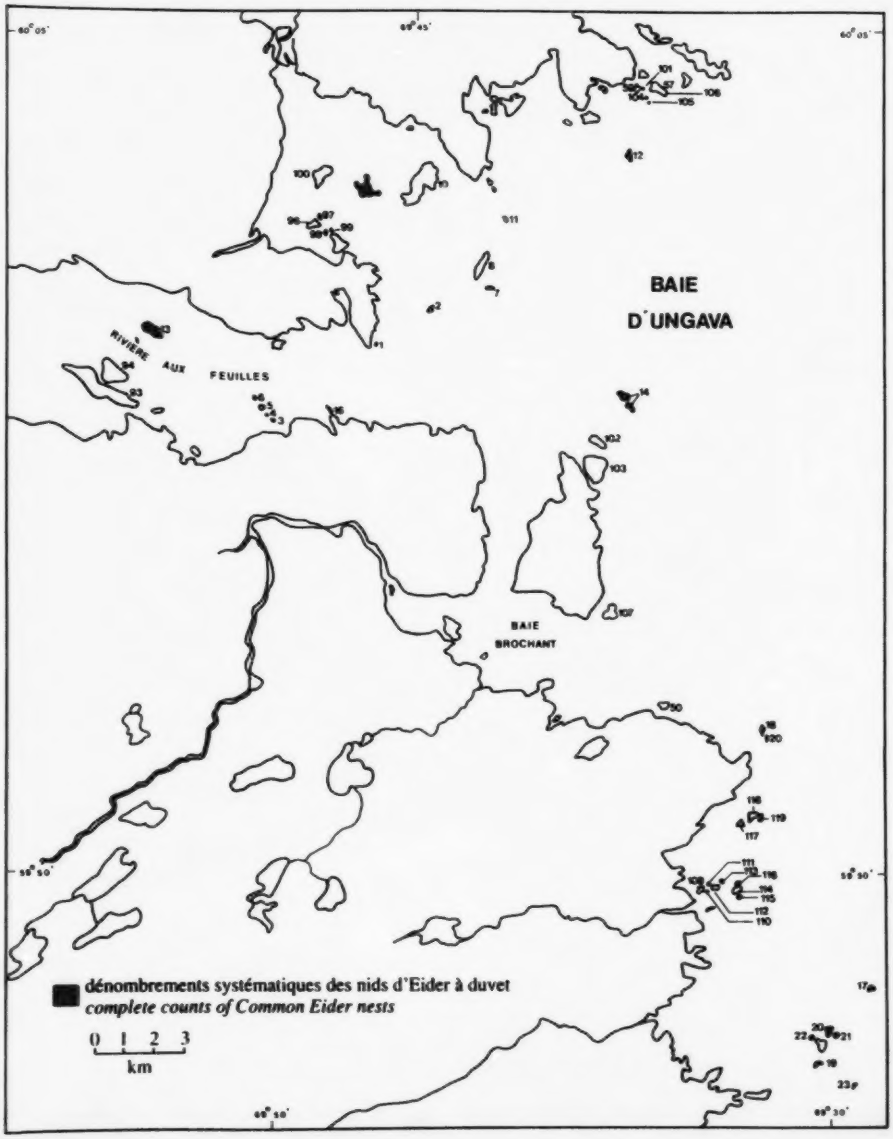
Nous avons examiné quelques sites à l'intérieur des terres connus des Inuit de la région où nichait l'Eider à duvet. Le premier site se situe à environ 26 km au nord-ouest des îles Gyrfalcon (figure 10). Nous y avons trouvé trois colonies dont l'estimation totale est de 238 nids (tableau 5). En considérant la superficie de l'îlot n° 1 (0,5 ha) (figure 10) où nous avons dénombré 151 nids, nous obtenons une densité de 302 nids/ha ce qui est supérieur à la densité maximum de 61,8 nids/ha obtenue dans l'archipel des îles Gyrfalcon. Nous avons aussi visité des sites de nidification à l'intérieur des terres à environ 26 km au sud-ouest des îles Eider (figure 11) et au lac Virgin situé à environ 25 km au nord-ouest de l'embouchure de la rivière Payne (figure 12). À ces derniers endroits, nous avons dénombré 323 et 303 nids respectivement (tableau 5). Tous ces sites de nidification se situent sur des îles en milieu d'eau douce et leur distance par rapport au milieu marin est de 2,5 km en moyenne. Au total, nous avons dénombré 864 nids à l'intérieur des terres.

Des recherches intensives à bord de l'hélicoptère dans des secteurs semblables au point de vue physionomique et configuration géographique ont été infructueuses. Nous concluons que les colonies à l'intérieur des terres sont peu nombreuses et très localisées.

Tableau 1
Coefficient de corrélation (*r*), coefficient de variation des superficies (CV*x*) et coefficient de variation des nids d'Eider à duvet (CVy) dans sept archipels de la baie d'Ungava, 1980
Correlation coefficients (r), coefficients of variation of surface areas (CVx), and coefficients of variation of Common Eider nests (CVy) for seven archipelagos, Ungava Bay, 1980

Archipel *Archipelago*	*r*	CV*x*,%	CVy,%
Archipel des îles Eider	0,49	220	144
Archipel des îles Plover	−0,23	134	145
Archipel des îles Payne	0,39	129	92
Archipel des îles Gyrfalcon	−0,12	109	125
Archipel E	−0,18	106	155
Archipel F	0,16	137	185
Archipel G	0,22	131	182

Figure 4
Archipel des îles Payne
The Payne Islands



7.1.3. Reproduction □

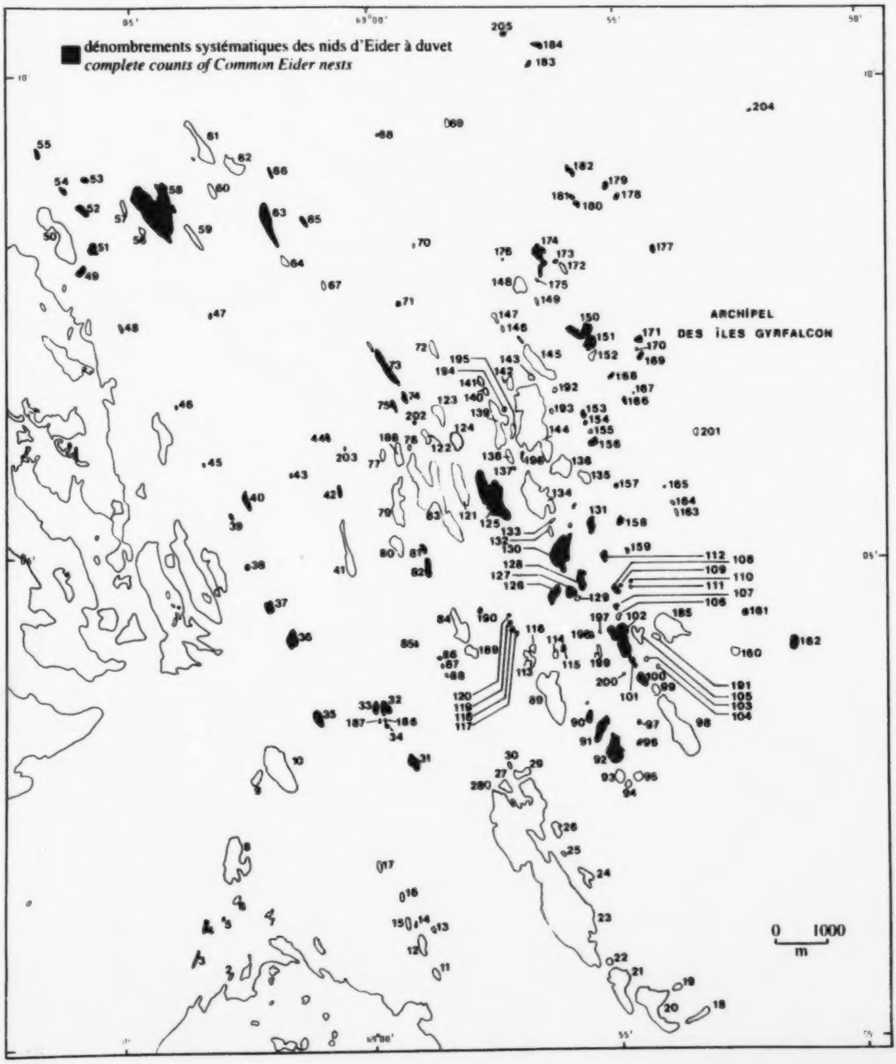
Au tableau 6, nous avons groupé la distribution du nombre d'oeufs par nid pour cinq archipels. Statistiquement, nous n'avons pas trouvé de différences significatives entre les archipels. La moyenne combinée des cinq archipels s'établit à 3,57. Cette valeur est très proche de 3,44 oeufs/nid rapportés pour l'Eider à duvet de la région de Cape Dorset en 1956 (Cooch, 1965), mais supérieure à la valeur de 3,11 (n = 429) observée en 1976 (Cooch, présente publication). Edwards (1957) a déjà rapporté une moyenne de 3,13 (n = 73) dans la région de Payne-Bay. Ailleurs dans l'Arctique, Prach *et al.* (présente publication) ont rapporté une moyenne de 3,30 (n = 544) dans les îles de la polynie Hell Gate – Cardigan Strait et Joensen et Preuss (1972) rapportent une moyenne de 3,40 (n = 1815) pour le district de Upernavik (Groenland).

Dans les îles Gyrfalcon, le premier nid en éclosion a été observé le 2 juillet. Le 14 juillet, 20 % (41) des nids trouvés cette journée-là (201) étaient soit éclos, soit en éclosion. Aux îles Eider, nous avons observé la première éclosion le 12 juillet et le 14 juillet seulement 2,8 % (2) des nids trouvés cette journée-là (69) étaient éclos ou en éclosion. Si nous considérons que la période d'incubation de l'Eider à duvet s'étale sur une période de 25 jours (Palmer, 1976) et que le rythme de la ponte est d'un oeuf par jour (Cooch, 1965), nous déduisons que la ponte a été initiée vers le 5 juin aux îles Gyrfalcon et le 14 juin aux îles Eider. Sur la côte est de la baie d'Ungava, la première éclosion a été rapportée le 4 juillet ce qui suggère le 6 juin comme date d'initiation de la ponte. Prach *et al.* (présente publication) ont trouvé des dates de ponte similaires à Hell Gate – Cardigan Strait situé à 2000 km au nord de la baie d'Ungava.

Nous avons classé les sites des nids en fonction du degré de protection vis-à-vis les éléments climatiques (ensoleillement et vents) et les prédateurs. Nous nous sommes inspirés des schémas de Belopol'skii (1961) et de nos propres observations dans la baie d'Ungava pour définir les cinq types de microhabitat illustrés au tableau 7. Le type 1 consiste en un surplomb rocheux sous lequel se trouve un nid *très bien* protégé de la vue des prédateurs et des vents. Le type 2 consiste, la plupart du temps, en deux parois entre lesquelles se trouve un nid *assez bien* protégé de la vue des prédateurs et des vents. Le type 3 protège *bien* mais présente plus de vulnérabilité que les deux types précédents. Le type 4 offre *peu* de protection mais crée un milieu qui par son relief et sa coloration contribue à la dissimulation de la femelle. Le type 5 n'offre *aucune* protection. Nous avons donc un gradient de protection à partir du type 1 vers le type 5 (le plus protégé vers le moins protégé). Nous pouvons également définir un gradient inverse pour l'ensoleillement, c'est-à-dire que le type 5 est celui qui pourrait recevoir le plus d'ensoleillement tandis que le type 1 en serait totalement privé; toutefois, nous n'avons pas spécifié l'orientation des côtés abrités et exposés des nids par rapport aux points cardinaux; donc ce critère doit être considéré comme un indice.

Le tableau 7 résume la répartition des nids parmi ces cinq types de microhabitat. Dans les deux archipels considérés, les nids ont été plus fréquemment observés dans le type 3. Toutefois, la distribution des nids dans les cinq types de microhabitat est significativement différente (χ^2 = 47,77, $p < 0,01$) entre les deux archipels. Cette différence est attribuable au nombre plus élevé de nids du type 2 dans les îles Eider. Cooch (1965) mentionne que 90 % des nids trouvés dans la région de Cape Dorset étaient protégés par une structure rocailleuse. Cette observation est similaire à la nôtre puisque nous avons 94 % des nids protégés par du roc (combinaison des quatre premiers types) pour l'ensemble des deux archipels. Nous avons aussi constaté une augmentation graduelle du nombre de nids détruits par rapport au gradient de protection (du plus protégé vers le moins protégé). Cette tendance est moins apparente dans les îles Gyrfalcon où le nombre de nids détruits est moins élevé qu'aux îles Eider. Étant donné que nous ne sommes pas en mesure de préciser quantitativement

Figure 5
Archipel des îles Gyrfalcon
The Gyrfalcon Islands


dénombrements systématiques des nids d'Eider à duvet
complete counts of Common Eider nests
ARCHIPEL DES ÎLES GYRFALCON
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m

Tableau 2

Résumé des dénombrements systématiques des nids d'Eider à duvet dans les archipels des îles Eider, des îles Plover, des îles Payne, des îles Gyrfalcon et les archipels E, F et G (voir figures 2, 3, 4, 5, 6, 7 et 8), baie d'Ungava, 1980

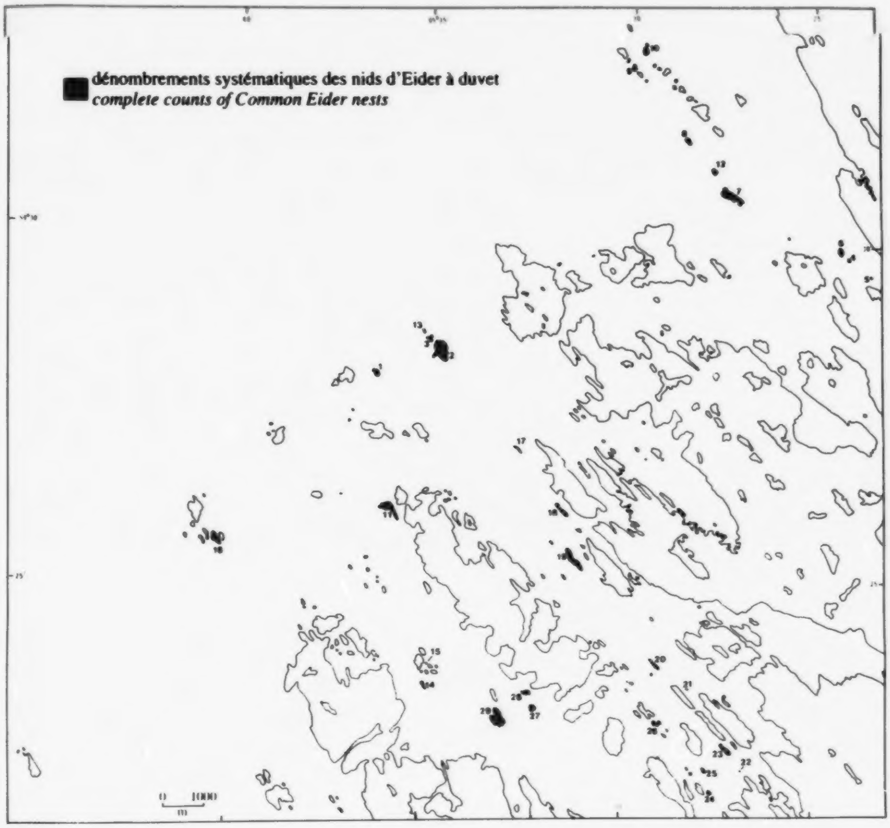
List of total counts of Common Eider nests on the Eider Islands, the Plover Islands, the Payne Islands, the Gyrfalcon Islands, and the archipelagos E, F, and G (see figs. 2, 3, 4, 5, 6, 7, and 8), Ungava Bay, 1980

Îles Eider *Eider Islands*		Îles Plover *Plover Islands*		Îles Payne *Payne Islands*		Îles Gyrfalcon *Gyrfalcon Islands*				E		F		G	
I*	N†	I	N	I	N	I	N	I	N	I	N	I	N	I	N
11	46	34	13	9	74	4	0	115	8	1	11	1	0	1	17
12	1	35	13	10	38	31	20	118	0	2	3	2	0	2	21
13	0	36	13	11	22	32	52	119	2	3	1	3	0	3	0
14	0	37	14	12	39	33	10	120	1	4	5	4	0	4	50
15	0	38	27	13	74	34	3	125	31	5	0	5	0	5	2
16	4	39	5	14	102	35	37	126	0	6	12	6	14	6	0
19	2	40	14	15	5	36	78	127	0	7	0	7	55	7	0
24	1	41	12	16	30	37	30	128	0	8	5	8	0	8	3
25	4	42	2	17	16	38	13	130	0	9	15	9	1	9	10
32	24	43	18	18	2	39	2	131	1	10	47	10	10	10	0
36	143	44	3	19	3	40	69	150	13	11	0	11	3	11	93
40	42	45	13	20	73	42	14	151	1	12	0	12	94	12	0
42	0	46	46	21	8	43	30	153	1	13	0	13	5	13	0
43	2	47	61	22	3	44	83	154	6	14	48	14	44	14	4
44	1	58	15	23	35	46	28	156	1	15	68	15	55	15	28
45	2	60	114			47	65	157	5	16	17	16	29	16	0
46	0	61	10			49	0	158	16	17	8	17	0	17	1
47	4	67	158			51	0	159	26	18	0	18	0	18	67
50	2	84	50			52	2	161	8	19	10	19	0	19	39
53	16	86	0			53	14	162	19	20	19	20	0	20	0
54	3					54	1	166	45	21	6	21	0	21	0
57	81					55	13	168	18	22	0	22	0	22	0
64	4					58	12	169	10	23	22	23	0	23	0
66,67	41					63	22	171	16	24	0			24	0
68	2					65	33	173	2	25	0			25	0
69	87					66	11	174	5	26	1				
71	3					71	28	177	5	27	11				
74	11					73	7	178	25	28	0				
102	116					74	0	179	45	29	2				
112	7					75	22	180	15						
114	71					81	12	181	6						
121	4					82	1	182	70						
129	32					85	27	183	9						
130	49					86	7	184	0						
133	4					87	1	186	3						
134	4					90	12	187	12						
135	7					91	8	190	31						
141	69					92	11	194	8						
142	82					96	81	196	0						
143	2					97	126	197	7						
144	1					100	0	198	13						
49	1					101	1	202	3						
160	52					102	13	203	44						
161	52					107	4	204	12						
						108	18	205	53						
						110	10								
						112	27								

*Numéro de l'île. * *Island number*.

†Nombre de nids. † *Number of nests*.

Figure 6
Archipel E
Archipelago E



dénombrements systématiques des nids d'Eider à duvet
complete counts of Common Eider nests
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m

Tableau 3
Estimation des populations d'Eider à duvet ($\hat{Y}$) dans sept archipels de la baie d'Ungava, 1980
Estimates of Common Eider populations ($\hat{Y}$) in seven archipelagos in Ungava Bay, 1980

Archipel *Archipelago*	N	n	Σy_i	$\bar{y}$	s^2	G_1	$\hat{Y}$
Archipel des îles Eider	167	44	1079	24,5	1249,0	1,60	4095
Archipel des îles Plover	45	20	601	31,0	1624,8	2,22	1557
Archipel des îles Payne	55	15	524	34,9	1022,7	0,82	1919
Archipel des îles Gyrfalcon	201	92	1654	18,0	525,3	2,18	3618
Archipel E	247	29	311	10,7	278,9	2,14	2642
Archipel F	123	23	310	13,5	627,9	1,95	1160
Archipel G	219	25	335	13,4	596,4	2,02	2934

NOTE:
N = Nombre d'îles dans l'archipel.
n = Nombre d'îles où des inventaires systématiques ont été effectués.
Σy_i = Nombre total de nids trouvés dans l'échantillon n.
$\bar{y}$ = Nombre moyen de nids par île dans l'archipel.
$s^2 = [\Sigma(y_i - \bar{y})^2]/(n\text{-}1)$
$G_1 = (1/Ns^3)\ \Sigma(y_i - \bar{y})^3$
$\hat{Y} = N\bar{y}$

NOTE:
N = *Number of islands in the archipelago.*
n = *Number of islands surveyed systematically.*
Σy_i = *Total number of nests found in sample n.*
$\bar{y}$ = *Mean number of nests per island in the archipelago.*
$s^2 = [\Sigma(y_i - \bar{y})^2]/(n\text{-}1)$
$G_1 = (1/Ns^3)\ \Sigma(y_i - \bar{y})^3$
$\hat{Y} = N\bar{y}$

la disponibilité de chacun des types de microhabitat, il est impossible de démontrer si l'Eider à duvet choisit un site de nidification plutôt qu'un autre à cause de sa disponibilité ou de la protection offerte par chacun des microhabitats.

Nous avons classé 1963 nids en fonction de quatre types de substrat (tableau 8). Dans les archipels des îles Eider et Gyrfalcon, 67,7 % des nids étaient construits sur un substrat de lichens, de mousses et d'*Empetrum*. Toutefois, la répartition des nids dans les quatre types de substrat est différente dans les deux archipels (χ^2 = 39,18, $p < 0{,}001$). Nous retrouvons beaucoup plus de nids sur un substrat dénudé dans les îles Eider. Cette observation suggère qu'advenant une exploitation du duvet sur une base commerciale, le produit en provenance de cet archipel serait plus facile à nettoyer.

7.2. *Somateria mollissima sedentaria* □

L'estimation de la population de la côte est de la baie d'Hudson a été obtenue d'après un inventaire aérien effectué le long de cette côte en 1978 (figure 1). Entre Pointe Louis XIV et Ivujivik, 1555 Eiders à duvet ont été dénombrés dont 732 mâles (Chapdelaine et Tremblay, 1979). Lors de ce même vol, 3689 eiders ont été observés dont 1716 mâles le long de la côte du détroit d'Hudson et de la baie d'Ungava (Ivujivik à Port Burwell). Or en 1980, nous avons estimé le nombre de nids entre Ivujivik et Port Burwell à 48 667 nids d'après nos inventaires au sol. Ceci représente un rapport de 28,4 nids pour chaque mâle observé durant le vol aérien de 1978. Cette observation nous amène à extrapoler la population d'Eider à duvet nichant le long de la côte est de la baie d'Hudson à 20 778 nids (28,4 × 732). Nous insistons toutefois sur le caractère approximatif et provisoire de cette estimation.

8. Analyse

Avant ces travaux, les seuls inventaires qui permettaient d'estimer la population d'Eider à duvet du secteur à l'étude provenaient des relevés aériens de Cooch (1954) et Chapdelaine et Tremblay (1979). Étant donné que ces relevés ne couvraient pas systématiquement tout le territoire et qu'ils ne respectaient pas toutes les conditions requises pour estimer une population d'Eider à duvet à partir d'un aéronef (Mendall, 1968; Almkvist *et al.*, 1974; Lock, présente publication), nous avons dû considérer les résultats de ces inventaires comme des indices d'abondance relative. De plus, il y a eu lieu d'être circonspect quant à l'obtention de résultats fiables d'après des inventaires aériens pour le secteur à l'étude en raison de l'irrégularité des

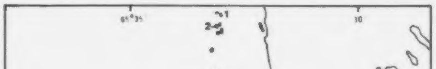
Nids d'Eider à duvet près d'un étang, îles Gyrfalcon
Common Eiders nests near a meltwater pond, Gyrfalcon Islands
(photo: R.S. Palmer)

conditions de glace, de l'immensité du territoire et du rapprochement des îles des archipels (figures 2 et 3) qui nous contraignent à effectuer des virées aériennes très serrées augmentant ainsi les risques de recomptage des oiseaux. Pour toutes ces raisons, nous optons pour des méthodes de dénombrement de nids au sol.

Les inventaires de 1980 ont permis d'établir avec une précision très respectable le nombre d'Eiders à duvet nichant dans la baie d'Ungava et la rive sud du détroit d'Hudson. Les informations sur la répartition des nids et la chronologie de nidification permettront de mieux planifier les inventaires de rappel. Par exemple, pour calculer les limites de confiance de l'estimation selon l'approximation normale pour les cinq archipels où les îles ont été sélectionnées au hasard, nous devrons inventorier 64 îles dans les îles Eider (38 %), 118 dans les îles Gyrfalcon (54 %) 114 dans l'archipel E (46 %), 95 dans l'archipel F (77 %) et 102 dans l'archipel G (48 %). Nous suggérons un inventaire de rappel à tous les 5 ans.

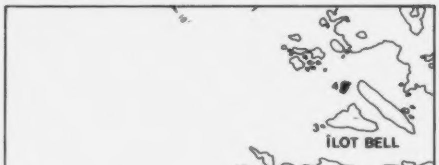
La présente étude et celle de Nakashima (présente publication) nous permettent d'examiner certains aspects de l'exploitation de la population d'Eider à duvet. Elle représente d'abord une source de nourriture importante (viande et oeufs) pour les communautés inuit du Nord québécois. À partir des données fournies par Reed (présente publication) environ 11 850 oeufs d'eider sont ramassés annuellement entre Maricourt et Port Burwell et 7150 oeufs entre Poste-de-la-Baleine et Akulivik. Ce ramassage représenterait environ 7 %

Figure 7
Archipel F
Archipelago F



■ dénombrements systématiques des nids d'Eider à duvet
complete counts of Common Eider nests

Figure 8
Archipel G
Archipelago G



■ dénombrements systématiques des nids d'Eider à duvet
complete counts of Common Eider nests

{[11 850 ÷ (48 664 × 3,57)] × 100 %} des oeufs produits entre le Cap de Nouvelle-France et Port Burwell et 10 % entre Poste-de-la-Baleine et Akulivik. Les mêmes communautés prélèvent environ 4750 eiders durant la période de reproduction (Reed, présente publication). Les Inuit pratiquent également la cueillette du duvet dans le cadre d'une activité familiale destinée à la fabrication des vêtements. Il existe aussi une exploitation du duvet sur une base commerciale, mais cette activité ne semble pas facile à implanter en raison de l'inaccessibilité du territoire et de l'absence d'immenses colonies de 2000 nids et plus comme dans l'estuaire du Saint-Laurent (Chapdelaine *et al.*, présente publication) et dans les fermes d'Islande (Palmer, 1976).

Cette population est aussi chassée durant la période automnale et hivernale le long des côtes du Labrador, de Terre-Neuve et de la côte nord du golfe du Saint-Laurent (Wendt et Silieff; Reed et Erskine; présente publication), mais l'impact de cette exploitation n'est pas connu.

Si nous voulons en arriver à une gestion rationnelle de cette ressource qui est exploitée à la fois sur ses sites de nidification, le long de sa route de migration et sur les sites d'hivernage, nous devons répéter les inventaires au sol destinés à mesurer les changements au sein de la population et déterminer avec plus d'exactitude les prises d'eiders et de leurs oeufs. Nous signalons également l'importance d'amorcer un programme de baguage qui permettrait une meilleure connaissance du nombre de prises par les chasseurs le long des routes de migration et sur les aires d'hivernage.

9. Remerciements

Nous tenons à remercier Moses Manik, Peter Nassak, Etoa Puttayuk, Stanley Anannack, Johnny George Anannack, Johnny Peters, Kitty Makiuk, Marc Allard, Mario Laverdière, Germain Tremblay et Charles-A. Drolet pour leur participation aux recensements. Nos remerciements s'adressent également à Ralph S. Palmer qui a accompagné l'équipe aux îles Gyrfalcon et Eider et avec qui nous avons eu des discussions très pertinentes concernant l'Eider à duvet. Austin Reed et Josepi Angma ont participé à la conception du projet et le ministère des Approvisionnements et Services Canada a contribué au financement du projet dans le cadre de son programme de propositions spontanées.

Tableau 4

Estimation de la population d'Eider à duvet dans la baie d'Ungava (Cap de Nouvelle-France jusqu'à Port Burwell) en 1980

The estimated number of Common Eider nests in Ungava Bay (Cap de Nouvelle-France to Port Burwell), 1980

	N	n	Σy_i	$\bar{y}$	s^2	G_1	$\hat{Y}$	± limites de confiance à 95 % *± confidence limits of 95%*
Baie d'Ungava	2813	213	3689	17,3	668,73	2,09	48 664	± 10 000 (±21 %)

NOTE:

N = Nombre d'îles dans l'archipel.

n = Nombre d'îles recensées dans cinq archipels de la baie d'Ungava (A, D, E, F, G).

Σy_i = Nombre total de nids trouvés dans l'échantillon n.

$\bar{y}$ = Nombre moyen de nids par île dans l'archipel.

$s^2 = [\Sigma(y_i - \bar{y})^2]/(n\text{-}1)$

$G_1 = (1/Ns^3)\ \Sigma\ (y_i - \bar{y})^3$

$\hat{Y} = N\bar{y} \pm (tNs/\sqrt{n}) = \sqrt{1-f}$ où $f = n/N$ d'après Cochran (1977) et $t = 1{,}96$.

NOTE:

N = *Number of islands in the archipelago.*

n = *Number of islands surveyed in five archipelagos (A, D, E, F, G).*

Σy_i = *Number of nests found in sample n.*

$\bar{y}$ = *Mean number of nests per island in the archipelago.*

$s^2 = [\Sigma(y_i - \bar{y})^2]/(n\text{-}1)$

$G_1 = (1/Ns^3)\ \Sigma\ (y_i - \bar{y})^3$

$\hat{Y} = N\bar{y} \pm (tNs/\sqrt{n}) = \sqrt{1-f}$ *where* $f = n/N$ *according to Cochran (1977), and* $t = 1.96$.

Tableau 5

Nombre de nids d'Eider à duvet dans trois sites à l'intérieur des terres (voir figures 9 et 10), baie d'Ungava, 1980

Number of Common Eider nests at three inland sites (see Figs 9 and 10), near Ungava Bay, 1980

Localisation *Region*	Nombre de nids *Number of nests*	Date d'inventaire *Date of survey*
Région des îles Eider		14 juillet 1980
Île n° 1	198	
2	—*	
3	62	
4	10	
5	13	
6	30	
7	5	
8	5	
Région du lac Virgin		22 juillet 1980
Île n° 1	92	
2	9	
3	23	
4	1	
5	12	
6	18	
7	30	
8	30	
9	9	
10	9	
11	70	
Région des îles Gyrfalcon		8 juillet 1980
Île n° 1	151	
2	63	
3	24	

* Aucun nid d'Eider à duvet, mais 15 nids de Goéland argenté. La seule île examinée à l'intérieur des terres qui hébergeait des nids de goéland.

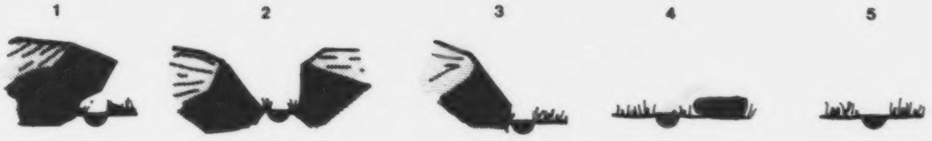
* *No Common Eider nests but 15 Herring Gull nests. The only island surveyed inland that harboured gulls.*

Tableau 6
Distribution du nombre d'oeufs d'Eider à duvet en fonction des cinq archipels de la baie d'Ungava, 1980
Clutch size of Common Eiders in five archipelagos in Ungava Bay, 1980

Archipel *Archipelago*	Date	Nombre d'oeufs par nid *Clutch size* 1	2	3	4	5	6	7	8	9	10	N^{bre} de nids *No. of nests*	N^{bre} moyen d'oeufs par nid *Mean clutch size*
Archipel des îles Eider	11 au 14 juillet	17	58	142	121	18	1	—	—	—	—	357	3,19
Archipel des îles Gyrfalcon	26 juin au 14 juillet	31	111	294	471	165	12	3	2	1	—	1090	3,57
Archipel E													
Archipel F	3 au 9 juillet	19	48	99	90	28	8	8	4	—	—	296	3,33
Archipel G	3 au 9 juillet	11	36	72	116	62	10	—	—	—	2	309	3,73
	3 au 9 juillet	12	29	73	135	67	16	1	—	—	2	335	3,84
Total		90	282	680	933	340	47	8	2	1	4	2387	3,57

*$F = 0{,}465$, $p > 0{,}05$ (dl = 4 et 2381). * *$F = 0.465$, $p > 0.05$ (d.f. = 4 and 2381).*

Tableau 7
Répartition et succès des nids d'Eider à duvet en fonction des cinq types d'habitat, baie d'Ungava, 1980
Distribution and success of Common Eider nests in relation to five habitat types, Ungava Bay, 1980



	1	2	3	4	5
Archipel des îles Eider					
N^{bre} de nids *No. of nests*	17 (3 %)	188 (33,3 %)	239 (42,4 %)	100 (17,7 %)	20 (3,6 %)
% de nids détruits *% destroyed*	0 %	13 %	11 %	15 %	20 %
Archipel des îles Gyrfalcon					
N^{bre} de nids *No. of nests*	129 (7,3 %)	363 (20,7 %)	815 (48,5 %)	346 (19,7 %)	100 (5,7 %)
% de nids détruits *% destroyed*	0,7 %	1,6 %	1,7 %	4,9 %	6 %
N^{bre} de nids total *Total nests*	146 (6,3 %)	551 (23,7 %)	1054 (45,5 %)	446 (19,2 %)	120 (5,3 %)
% total de nids détruits *% of all nests destroyed*	0,6 %	5,6 %	4,8 %	7,1 %	8,3 %

Tableau 8
Répartition des nids d'Eider à duvet en fonction de quatre types de substrat, baie d'Ungava, 1980
Distribution of Common Eider nests in relation to four types of substrate, Ungava Bay, 1980

Localisation *Region*	Cailloux et gravier *Rock and gravel*	Terreau *Bare humus*	Herbe (*Elymus*) *Grass (Elymus)*	Lichens, mousses et *Empetrum* sp. *Lichens, mosses and Empetrum sp.*
Archipel des îles Eider	182 (32,2 %)	23 (4,1 %)	21 (3,7 %)	340 (60,0 %)
Archipel des îles Gyrfalcon	211 (18,7 %)	48 (4,3 %)	62 (5,5 %)	806 (71,5 %)
Total	393 (23,2 %)	71 (4,2 %)	83 (4,9 %)	1146 (67,7 %)

Figure 9
Représentation schématique des déplacements d'observateurs effectuant des inventaires systématiques de nids d'Eider à duvet sur des îles de la baie d'Ungava
Pattern of movements of observers conducting total counts of eider nests on islands in Ungava Bay

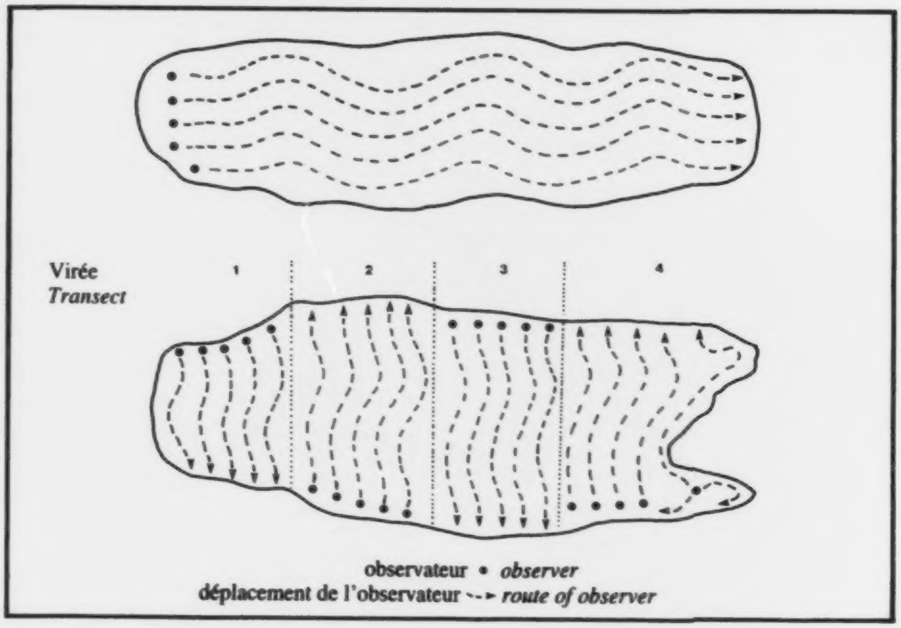

Virée
Transect
1
2
3
4
observateur • observer
déplacement de l'observateur --► route of observer

Figure 10
Sites de nidification de l'Eider à duvet (1 à 3) en milieu d'eau douce au nord-ouest des îles Gyrfalcon, baie d'Ungava, 1980
Inland breeding sites (1–3) of Common Eiders northwest of the Gyrfalcon Islands, Ungava Bay, 1980

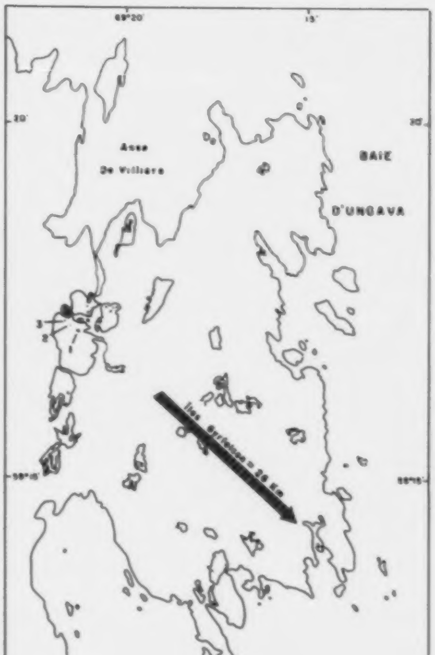

69°20'
15'
20'
Anse
De Villiers
BAIE
D'UNGAVA
3
2
1
Îles Gyrfalcon ≈ 25 Km
59°15'
BAIE
IKATTOK
0
1
2
km

Figure 11
Sites de nidification de l'Eider à duvet (1 à 8) en milieu d'eau douce au sud-ouest des îles Eider, baie d'Ungava, 1980
Inland breeding sites (1–8) of Common Eiders southwest of the Eider islands, Ungava Bay, 1980

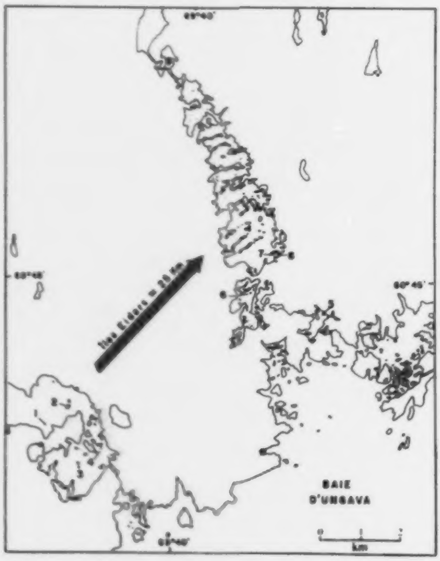
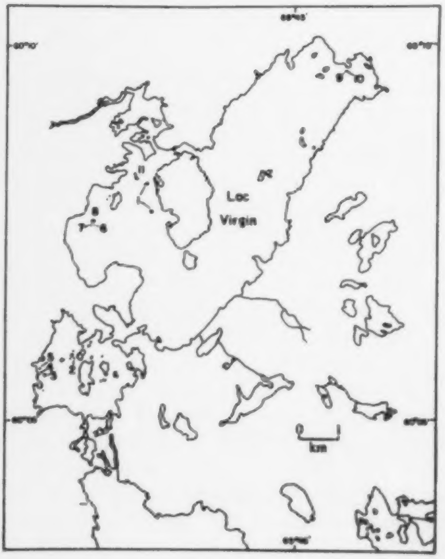

69°40'
Îles Eiders ≈ 25 Km
7
8
6
60°45'
BAIE
D'UNGAVA
0
1
2
km

Figure 12
Sites de nidification de l'Eider à duvet (1 à 11) dans le lac Virgin au nord de Payne-Bay, 1980
Breeding sites (1–11) of Common Eiders in Virgin Lake north of Payne-Bay, 1980


9
10
11
Lac
Virgin
8
7
6
0
km

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Observations of Common Eiders in Hudson Strait: aerial surveys in 1980–83

Observations de l'Eider à duvet dans le détroit d'Hudson : relevés aériens de 1980 à 1983

A.J. Gaston
F.G. Cooch

1. Abstract

Eiders were counted along coasts and land-fast ice-edges in Hudson Strait during aerial surveys in 1980–83. Large numbers of Common Eiders were seen along the south coast of Baffin Island in mid-April and mid-June at the ice edge between Markham Bay and Cape Dorset. The bulk of birds probably arrive in this area in the first half of April. Breeding season surveys were limited to the vicinity of Ivujivik, Quebec, where only small numbers breed. In September, moulting concentrations of female Common Eiders were located on the west coast of Nottingham Island and on the south shore of Hudson Strait, east of Deception Bay. Over 3500 males, the majority probably moulting, were seen between Lake Harbour and 68°W on the south coast of Baffin Island. A crude minimum estimate for the breeding population of Common Eiders in Hudson Strait, excluding Ungava Bay, is 24 000 pairs, most being found on the north side of Hudson Strait.

2. Résumé

Des Eiders à duvet ont été dénombrés le long des côtes et des glaces fixes dans le détroit d'Hudson lors de relevés aériens effectués entre 1980 et 1983. Les eiders étaient abondants près de la côte sud de l'île de Baffin à la mi-avril, et à la mi-juin près des glaces entre Markham Bay et Cape Dorset. La majorité de ces eiders arrivent, probablement, dans la première moitié d'avril. En période de reproduction, les relevés étaient limités à la région d'Ivujivik (Québec) où peu d'eiders nichent. En septembre, des concentrations de femelles en mue ont été vues sur la côte ouest de l'île Nottingham et sur la rive sud du détroit d'Hudson à l'est de la baie Déception. Plus de 3500 mâles, dont la majorité étaient en mue, ont été observés entre Lake Harbour et le 68° O, le long de la côte sud de l'île de Baffin. Une estimation approximative de la population reproductrice de l'Eider à duvet dans le détroit d'Hudson, et qui n'inclut pas la baie d'Ungava, indique 24 000 couples dont la majorité nichent sur le côté nord.

3. ᓄᐃᑎᑕᐅᔪᑦ

ᒥᑏᑦ ᑭᓯᑕᐅᓐᓂᖃᑦ ᓯᓇᖓᓂ ᐊᒻᒪᓗ ᓄᓇᐅᑉ ᑐᕙᖓᑕ ᓯᓇᓂ ᒪᓂ ᓇᔪᒐᓕᑦ ᐊᑦᓴᓐᓱᑐᓇᑦᒥ ᖃᖓᑦᑕᔪᒃᑯᑦ ᐊᑦᔾᔨᓕᐅᓇᓂᖃᓯᒪᑎᓪᓗᒍ 1980–1983-ᒥ. ᐊᒥᓱᕋᑕᐃᓪᓗ ᒥᑏᑦ ᑕᑯᔭᐅᓯᒪᔪᑦ ᕿᑭᖅᑕᓗᑉ ᓯᕿᓂᖓᑦᑕ ᓯᓇᓂ ᐊᐃᓇᓕᐅᑉ ᑕᕿᖓᑕ ᕿᑎᖓᓂ ᐊᒻᒪᓗ ᔪᓂᐅᑉ ᑕᕿᖓᑕ ᕿᑎᖓᓂ ᑐᕙᐅᑉ ᓯᓇᓂᑦᓯᑎᒃ Markham Bay-ᒧ ᑭᖓᐃᓗ ᐊᑯᓐᓂᖓᓐᓂ. ᑕᒪᒃᑯᐊ ᒥᑎᑦ ᐊᒥᓱᕋᑕᐃᑦ ᑎᑭᓯᕙᔪᑦᓴᐅᕗᑦ ᑕᒪᐅᖓ ᓄᓇᒧᑦ ᐱᒋᐊᖓᓂᖕᔭᖓᓂ ᑕᕿᖓᑕ ᐊᐃᓇᓕᐅᑉ. ᒪᓐᓂᓕᐅᕐᓂᕙᓪᓗ ᖃᖓᐅᑎᓪᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᒪᒋᕗᑦ ᐃᓱᓕᓯᒪᓂᖃᓯᑎᒃ ᐃᕗᔾᔨᕕᒻᒧᑦ, ᑯᐸᐃᒻᒥᑐᒧᑦ. ᐃᑭᑦᑐᐊᐱᓪᓗ ᑭᓯᐊᓂ ᒪᓐᓂᓕᐅᓯᕙᑦᓯᑎᒃ. ᓯᑦᑕᒻᐸᐅᓕᕐᑎᓗᒍ. ᕗᓂᒍᕐᑕᐸᓪᓗᐊᓂᕐᓂᕙᑦ ᐊᕐᓇᓗᕙᑦᑕ ᒥᑏᑦ ᓇᐃᐱᑕᐅᓐᓂᕗᑦ Nottingham Island ᓯᕿᓂᖓᓂ ᐊᒻᒪᓗ ᓯᕿᓂᖓᑕ ᓯᓂᖓᓂ ᐊᑦᓴᓐᓱᑐᓇᑦᒥ. ᓴᓪᓗᐃᑦ ᐊᐃᑉᐸᖓᑕ ᑕᕐᕋᓂ. ᐅᖓᑕᓂᑦᑐᑦ 3500 ᐊᖑᓴᓪᓗᐃᑦ. ᐃᓗᐊᓐᓇᓕᒪᑲᓴᕙᓪᓗ ᒥᕗᓯᓯᕗᔪᑦᓴᐅᔪᑦ. ᑕᑯᔭᐅᓐᓂᕗᑦ ᓴᓪᓖᓗ ᐊᒻᒪᓗ 68°W ᑕᕐᕋᖓᓂ ᒪᓂᑦᓯᑎᒃ ᕿᑭᖅᑕᓗᑉ ᓯᕿᓂᖓᓂ. ᖃᐅᔨᒪᔭᐅᓪᓚᓇᒐᑎᒃ ᒪᓐᓂᓕᐅᕐᑐᑦ ᒥᑏᑦ ᐊᑦᓴᓐᓱᑐᓇᑦᒥ. ᐃᓚᒃᓯᑎᒃ ᐅᖓᐸᒥᑦᑐᓂᒃ. 24,000 ᐊᓐᖑᓴᓪᓗᒥᑦ ᐊᕐᓇᓗᒥᑦᓯᑎᒃ ᑕᑯᔭᐅᓗᐊᖑᐊᓯᕗᔪᑦ ᑕᕐᕋᖓᑕ ᓯᓂᖓᓂ ᐊᑦᓴᓐᓱᑐᓇᐅᑉ.

4. Introduction

During 1980–83, a series of aerial surveys were flown over Hudson Strait to determine the distribution of pelagic seabirds (Gaston 1982, Gaston *et al.* 1985). In the course of these surveys, notes were kept of all other birds and marine mammals observed, including eiders (*Somateria* spp.). Although the surveys were not specifically designed to count eiders, a considerable amount of information was collected on these ducks. Because few data are available for Hudson Strait, we have attempted to summarize the observations here.

Although good information is available for small areas, such as the West Foxe Islands (Cooch 1965), there has been no systematic attempt to inventory eiders over the whole of Hudson Strait, despite the fact that the area is thought to hold a large population of the Northern Eider (*Somateria mollissima borealis*) (Abraham and Finney, this publication). Previous surveys of the area include Chapdelaine, Bourget *et al.* (this publication) in Ungava Bay, in July 1978 and 1980, using aerial and ground surveys, MacLaren Marex (1979) on the southeast coast of Baffin Island in April to December 1978 and LGL Ltd (P. L. McLaren, pers. commun.) throughout Hudson Strait in March 1981 using deHavilland Twin Otters, and Cooch (1954) in June 1954, using a Canso flying boat.

5. Methods

We used a deHavilland Twin Otter aircraft with two observers: one seated in the copilot's seat on the right side of the aircraft, and the other in the second passenger seat on the left. Observers noted all details, including the time to the nearest minute, on a cassette tape recorder. They also recorded the time of beginning and ending each survey segment and the time at which the aircraft passed landmark features so that all observations could be accurately located. On most surveys, fixing the position of the aircraft was made easier by the presence of a Global Navigation System.

The aircraft flew at 50–60 m altitude at ground speeds ranging from 160 to 220 km/h, depending on wind speed and direction. We flew surveys along coasts at 0.5–1 km offshore and those along land-fast ice-edges at approximately 400 m from the ice-edge. In June 1983, in areas where heavy pack-ice completely covered the water adjacent to the fast-ice edge, we deliberately sought out areas of open water and flew over them to check for birds, but all observations made on ice-edge transects were within 2 km of the land-fast ice. On most surveys we did not turn into deep narrow inlets, but instead, cut straight across their mouths, not surveying small areas of possible eider habitat at their heads.

Our methods followed, in general, those described by Johnson *et al.* (1976), Nettleship and Gaston (1978), and McLaren (1982). They differed from those employed by Lock (this publication) in not making any special attempt to cover all available eider habitat. Consequently, it is unlikely that, except in the case of the ice-edge surveys carried out in April 1981 and June 1983, we counted more than a fraction of the birds present. Nevertheless, comparisons of our counts among different areas are probably valid.

We flew surveys on five dates in 1980, on two dates in 1981, and on one in 1982 and 1983 (Fig. 1 and Table 1).

Because the surveys were designed for other purposes, the coverage of suitable coast for eiders was uneven. The most extensive surveys took place in September 1980 on the south coast of Hudson Strait as far east as Wakeham Bay and on parts of the north coast. At that date, most female eiders and some males were probably moulting (Cooch 1965).

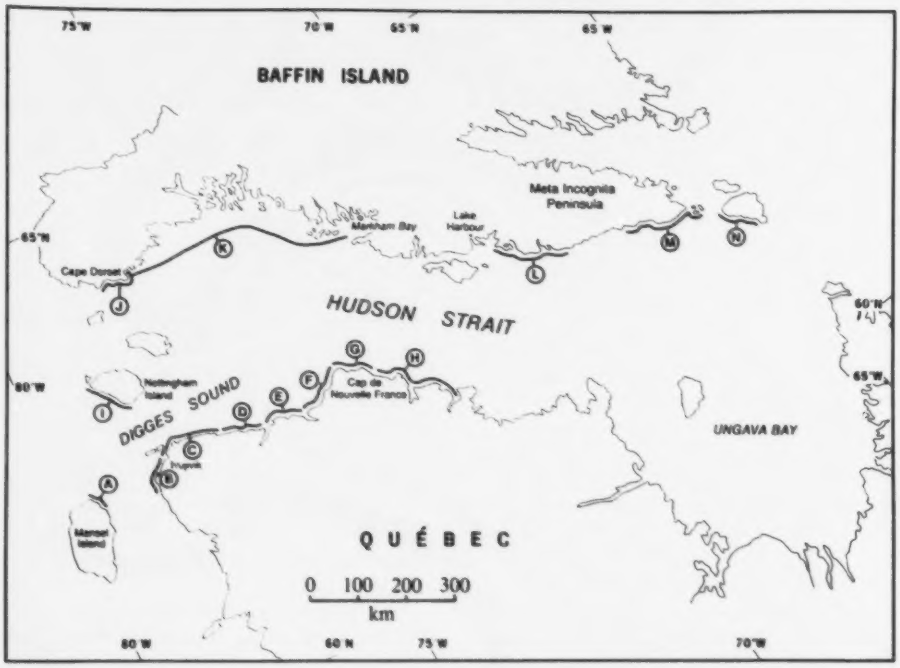
We surveyed the north coast of Hudson Strait between Cape Dorset and Markham Bay, believed to harbour a large eider population (Cooch 1954), twice, in April 1982 and in June 1983. During these surveys, land-fast ice extended to the outermost coastal islands and eiders were concentrated in open water areas along the ice-edge. This simplified the survey route by making it unnecessary to follow the indentations of the highly convoluted coastline. The eiders were concentrated by the ice within a narrow strip where they could conveniently be counted. The location of the floe edge was similar on both surveys, but in June some patches of open water were present within the land-fast ice which were absent in April. We made detours to inspect these. The other important eider area on the north coast, to the east of Big Island (Bruemmer 1982), we surveyed only in September. Surveys also took place in

Table 1
Dates of aerial surveys for each sector shown in Figure 1
Dates des relevés aériens effectués dans chacune des régions illustrées à la figure 1

Survey date *Date du relevé*	Sectors flown *Régions survolées*
3 Sept. 1980	A, B, C, I, J
4 Sept. 1980	H
9 Sept. 1980	D, E, F, G
13 Sept. 1980	L
19 Sept. 1980	M, N
9 July 1981	A, I
9 Aug. 1981	A
16 April 1982	J, K
21 June 1983	K

The Middle Savage Islands off the south coast of Baffin Island, an important breeding area for Common Eiders
Les îles Middle Savage, au large de la côte sud de l'île de Baffin, hébergent une population importante d'Eider à duvet en période de reproduction
(photo: F. Bruemmer)

Figure 1
Map of aerial survey routes along the coasts of Hudson Strait in 1980–83
Le détroit d'Hudson montrant les trajets des relevés aériens, de 1980 à 1983



July and August 1981 but these covered only small areas of eider habitat near Ivujivik, Quebec.

6. Results

The earliest survey, on 16 April 1982, covered only sectors *J* and *K*, the land-fast ice-edge between Markham Bay and Cape King Charles. We estimated 8340 eiders, mainly in very large flocks of more than 1000 birds ($\bar{x} = 556$, SE = 191.1, $N = 15$). Both sexes were present, but males predominated, comprising more than 80% of those counted. However, light conditions were poor and some females may have been overlooked. Cooch (1965) described the changing sex composition of migrants at Cape Dorset where sex ratios were initially heavily skewed towards males and only reached a semblance of parity by late June.

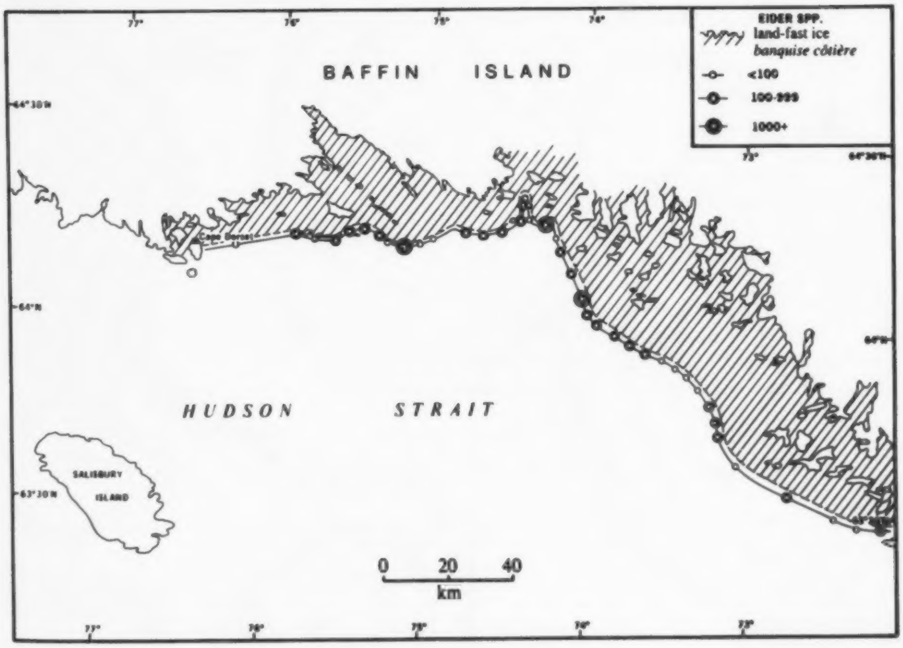
All birds positively identified were Common Eiders. Because of the size of flocks and difficulty in seeing females because of poor light conditions, estimates were probably subject to considerable error (McLaren 1982). However, probably a minimum of 8000 birds were present. Most of the flocks occurred where small islands emerged at the ice-edge. We recorded no eiders west of Cape Dorset.

On 21 June 1983, the same ice-edge was surveyed as far west as Cape Dorset. Numbers appeared to be higher than in April with a total of 14 200 estimated, including 540 King Eiders (*Somateria spectabilis* (Fig. 2). The majority again appeared to be males, but the proportion of females appeared greater than in April. Over their nesting islands, the cryptic coloration of the females may have again led to underestimation. Flocks were generally smaller than in April, with many birds in pairs or small groups, but one aggregation on a patch of open water surrounded by solid pack-ice was estimated at 3000.

Some tidal polynyas, enclosed by fast-ice, and some small open water areas in pack-ice close to the ice-edge were not surveyed and these may have supported additional eiders. Also, birds were ashore on several islands, flying off at the approach of the aircraft. Experience elsewhere suggests that birds on land either do not flush as easily as those on the water, or are less visible. In any event, these factors suggest that our figures are probably a minimum estimate. We saw relatively few around the West Foxe Islands and between there and Cape Dorset, supporting the contention of Cooch (this publication) that the large population formerly breeding in that area has been considerably reduced.

Surveys in July and August 1981 covered only three small strips of coast between Digges Sound and Kovic Bay, on the east coast of Hudson Bay (sector *B*), a small part of the coast of Mansel Island (sector *A*), and the west coast of Nottingham Island (sector *I*). Largest numbers were recorded on 9 July 1981, when 32 Common Eiders were recorded on sector *A*, 180 on sector *B*, and 283 on sector *I*. Most of these birds were in pairs or small parties of mixed sex and were presumably breeding. An estimate of the breeding population of Digges Islands, Nuvuk Islands and adjacent archipelagos, south to Ice Harbour (62°19′N) in 1980–83 by Gaston *et al.* (1985) was about 400 breeding pairs. They found no evidence of breeding King Eiders, although a few summered in the Digges Sound area.

Figure 2
Distribution of eiders recorded along the south coast of Baffin Island on 21 June 1983
Distribution des eiders le long de la côte sud de l'île de Baffin, le 21 juin 1983



Surveys in September 1980 revealed major concentrations of Common Eiders in three areas: sector *F*, to the east of Deception Bay, where 830, all females and juveniles apparently moulting, were counted; sector *I* (Nottingham Island) where 1126 moulting females and juveniles were seen; and sector *L* where 3544 males were recorded (Fig. 3); the majority showing signs of partial eclipse plumage, presumably moulting. The latter concentration apparently extended at least as far as 68°W, where about 200 were seen while the aircraft was inbound across the coast, but numbers were much lower on sector *M*. No King Eiders were recorded in September.

7. Discussion

Partial surveys of the ice-edge along the north shore of Hudson Strait in late March 1981 revealed only small numbers of eiders in the Markham Bay – Cape Dorset sector (LGL, unpubl.). Consequently the bulk of eiders seen on 16 April 1981 had probably arrived during the previous 2 weeks. A few birds may overwinter where the shore-lead persists. Common Eiders have been reported wintering to the west around Southampton Island (Eifrig 1905, Sutton 1932), and to the east on the south coast of Meta Incognita Peninsula (Soper 1946). However, eiders are not generally seen off Cape Dorset or Ivujivik, Quebec, in winter (local hunters, pers. commun.). Eiders over-winter at several locations on the Quebec side of Hudson Strait (Nakashima, this publication) and are abundant off the northern tip of Labrador in March (MacLaren Marex 1979), although the proportion of Common versus King Eiders in these flocks is unknown. Over-wintering of eiders to the west of Markham Bay remains a possibility that can only be proven by surveys earlier in the year.

The discovery of a major concentration of apparently moulting male Common Eiders between Lake Harbour and the Middle Savage Islands adds significantly to the numbers of male Common Eiders known to moult in the eastern Arctic (Abraham and Finney, this publication), although the numbers involved may not exceed the number of birds breeding locally (Bruemmer 1982). The concentrations of females and young on western Nottingham Island and along the south shore of Hudson Strait, east of Deception Bay, may exceed the numbers breeding along those coasts (see following paragraph) but are not large enough to require immigration from outside the Hudson Strait area.

Outside of that part of the south coast surveyed by Chapdelaine, Bourget *et al.* (this publication) it is difficult to assess the size of the Common Eider population in Hudson Strait. Our surveys and those of Chapdelaine, Bourget *et al.* (this publication) and Nakashima (this publication) suggest that the remainder of the south coast harbours relatively few breeders, probably no more than 1000 pairs altogether. Our counts on western Nottingham Island suggest that the island probably supports several hundred pairs of Common Eiders and with Mill, Salisbury, and Charles Islands and the 400 pairs around Digges Sound, we can probably assume at least a thousand pairs for the Hudson Strait Islands.[1] On the north shore of Hudson Strait, between Cape Dorset and Markham Bay, there are probably at least 10 000 pairs of Common Eiders, but from there, east to Lake Harbour, densities are probably lower by a factor of 8 (Cooch 1954), suggesting perhaps 1000–2000 pairs altogether. From Lake Harbour eastwards, Cooch's survey suggested densities similar to those west of Markham Bay and "thousands" certainly breed in the Middle Savage Islands (Bruemmer 1982). We can probably assume at least another 10 000 pairs, and hence a minimum of about 24 000 pairs for the whole of Hudson Strait, excluding Ungava Bay. The true figure could be twice as high but detailed surveys of the type carried out in Labrador by Lock (this publication) or in Ungava Bay by Chapdelaine, Bourget, *et al.* (this publication) will be needed before a final figure can be reached.

8. Acknowledgments

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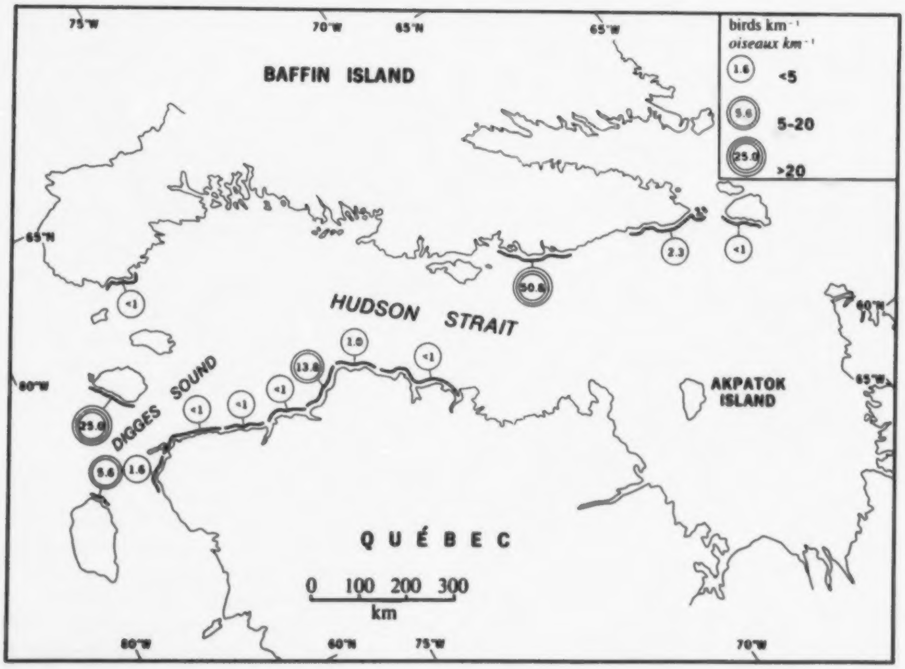
Figure 3
Densities of eiders recorded on aerial surveys in Hudson Strait during September 1980
Densités des eiders le long des côtes du détroit d'Hudson, septembre 1980



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[1] Observations by R. Decker (pers. commun.) in July 1984 revealed several thousand Common Eiders associated with small islets off northwest and eastern Nottingham Island and several hundreds on Mill and Salisbury Islands. Hence a figure of 3–5000 pairs for the major Hudson Strait islands may be more appropriate.

Eiders of the eastern Canadian Arctic

Eiders de l'est de l'Arctique canadien

K.F. Abraham
G.H. Finney

1. Abstract

A literature review of Common and King Eider populations of the eastern Canadian Arctic reveals that data on numbers, seasonal distribution, and breeding resources are not currently adequate for effective management. Fragmentary data allow preliminary estimates of 45 000 breeding birds in the Hudson Bay Eider population and 184 000 breeding birds in the Northern Eider population but estimation of the King Eider population was not practicable. We summarize available information on seasonal ranges; nesting, moulting, and staging locations; and migration routes for each population, and discuss the need for additional surveys and research.

2. Résumé

Une revue de la littérature concernant l'Eider à duvet et l'Eider remarquable de l'est de l'Arctique canadien démontre que nos connaissances sur leurs effectifs, leur distribution saisonnière ainsi que les ressources requises pour leur reproduction sont actuellement insuffisantes pour gérer adéquatement ces populations. Les données existantes permettent, néanmoins, une estimation préliminaire de quelque 45 000 oiseaux-nicheurs de la sous-espèce de l'Eider à duvet *Somateria mollissima sedentaria* et 184 000 de la sous-espèce *S. m. borealis*, mais ne permettent pas d'évaluer la population de l'Eider remarquable. Nous résumons les informations existantes concernant les aires occupées en différentes saisons, la nidification, la mue, les haltes migratoires et les routes de migration pour chaque population. Nous discutons également des besoins en matière de recherche et des relevés de population.

3. ᓄᐃᑎᑕᐅᔪᑦ

ᐊᓪᓚᓕᐊᕆᔭᐅᒪᔪᑦ ᕿᒥᕐᕈᔭᐅᒪᑦᓯᑎᑉ ᒥᑏᑦ ᕿᖓᓖᖕᓄ ᒫᓂ ᓯᕿᓂᖓᓂ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᖓᓂ ᓄᐃᑎᑦᓯᔪᖕ ᑖᒃᑯᐊ ᐱᓇᓱᑦᑕᐅᒪᔪᑦ ᐊᒥᓲᓂᖏᑎᒍᑦ. ᐅᐱᖅᖓᓴᒥᒍ ᓄᓇᖓᓂᖃᓱᖏᑦ. ᐊᒻᒪ ᒪᖓᓕᐅᖅᓂᖏᑦᑕ ᐱᐱᑦᓴᖏᑦ ᓇᒻᒪᖏᑦᑐᒥᐊᖏᑦ ᐊᐅᓚᑕᐅᓂᖃᕗᖅᑕᖓᓄᑦ. ᐃᓚᐃᖓᖓᒍᑦ ᐱᓇᓱᑦᑕᐅᒪᓂᖓ ᓱᕈᐃᓯᓯᒪᔫᖕ 45,000 ᒪᖓᓕᐅᓱᖑᒥᐊᖏᑦ ᒫᓂ ᐊᑦᓴᖓᐸᐃ ᒥᑎᖑᑎᖏᖕᓂ ᐊᒻᒪ 184,000 ᒪᖓᓕᐅᖅᑐᑦ ᒫᓂ ᑕᖅᕋᐅᑉ ᒥᑎᖑᑎᖏᖕᓂ ᑭᓯᐊᓂ ᑭᓯᑕᐅᒪᓂᖃᕗᖏᑦ ᐅᑯᐊ ᒥᑏᑦ ᕿᖓᓕᑦ ᐊᒥᓲᓂᖏᑦᑕ ᐊᑐᑎᐅᓪᓗᐊᖏᒥᐊᖏᑦ. ᓇᐃᓕᑎᖅᓯᓯᒪᕗᑦ ᑐᑭᓯᓂᐊᕈᑎᐅᒍᓐᓇᑐᓂᒃ ᒫᓂ ᐊᖅᓴᒍᑕᒪᖑᔪᒥ. ᒪᖓᓕᐅᖅᐱᓂᑦ, ᒥᖑᐃᕗᖅᐱᖏᓐᓂᒃ, ᐊᒻᒪ ᓄᐃᑕᑎᑦᓯᓯᑎᒃ ᓇᓂᓐᓂᖏᓐᓂᒃ ᐊᒻᒪ ᐊᐅᓚᓂᖓᓱᖏᓐᓂᒃ ᐊᑐᓂᑦ ᒥᑎᖅᓄᑦ. ᐊᒻᒪ ᑲᑎᒪᔪᑎᖅᓯᑎᒃ ᖁᐅᔑᓴᖓᐊᖅᓚᖓᒥᐊᖅᓂᒥᒃ ᐊᒻᒪ ᑭᓯᑕᐅᒥᐊᖅᓂᖏᓐᓄᑦ.

4. Introduction

The extent and relative inaccessibility of Canada's eastern Arctic has hindered repeated, systematic inventories of its waterfowl populations. Thus, although Common Eiders (*Somateria mollissima*) and King Eiders (*S. spectabilis*) are conspicuous and widespread, our knowledge of their numbers, distribution, and movements is incomplete. What data we have was collected in brief episodes over many decades, in relatively few locations, and often incidentally to other research.

Increasing human populations and industrial development in northern areas threaten waterfowl resources. The conservation and management of these resources depends largely on our ability to monitor population trends accurately. To do this well we need a sound information base for each species. In this paper we summarize available information on the eastern Arctic populations of Common and King Eiders. We sought particularly data on breeding distribution and numbers but also researched moulting, wintering, and staging areas, and migrations between these sites.

Within our study area (Fig. 1) are found two subspecies of Common Eider (the Hudson Bay Eider *S. m. sedentaria* and the Northern Eider *S. m. borealis*) and King Eiders. The area's western boundary (a line through M'Clintock Channel and Viscount Melville Sound) coincides with a hiatus between the breeding ranges of *borealis* and the Pacific Eider (*S. m. v-nigra*) (Palmer 1976). The line also represents a "migratory divide" between western and eastern wintering King Eiders (Salomonsen 1968). In the south the area includes the Hudson Bay coasts of the NWT, Manitoba, Ontario, and Quebec, and the James Bay coasts of Ontario and Quebec. It includes all islands of Hudson, James, and Ungava Bays and all islands in and north of Hudson Strait. Detailed descriptions of eider populations along the Quebec coasts of James Bay, Hudson Bay, Hudson Strait, and Ungava Bay and the adjacent Labrador coast are provided in other articles in this publication (Chapdelaine, Bourget, *et al.*; Gaston and Cooch; Lock; Nakashima).

5. Hudson Bay Eiders

5.1. General distribution □

Hudson Bay Eiders, first described by Snyder (1941), are year-round residents of James and Hudson Bays (Fig. 2 and Table 1). Pre-1940 records of Common Eiders in these areas usually referred them to the American Eider (*S. m. dresseri*). In summer, they inhabit the entire coast of Hudson Bay from Chesterfield Inlet in the northwest to James Bay and north along the east coast of Hudson Bay to Cape Smith. In winter, they use open water areas near the Belcher Islands, shore-leads along the south and west Hudson Bay coasts and, possibly, polynyas in the north and northwest portion of Hudson Bay.

The range of Hudson Bay Eiders meets or overlaps that of Northern Eiders in northern Hudson Bay. The area of contact is considered to be in the Cape Fullerton – Chesterfield Inlet region (Fig. 1), but the line of demarcation and status of each subspecies and intergrades is not firmly established. The subspecific identity of nesting Common Eiders on Southampton,

Figure 1

Map of the eastern Canadian Arctic showing many of the place names given in the text

Carte de l'est de l'Arctique canadien montrant plusieurs noms de lieux mentionnés dans le texte

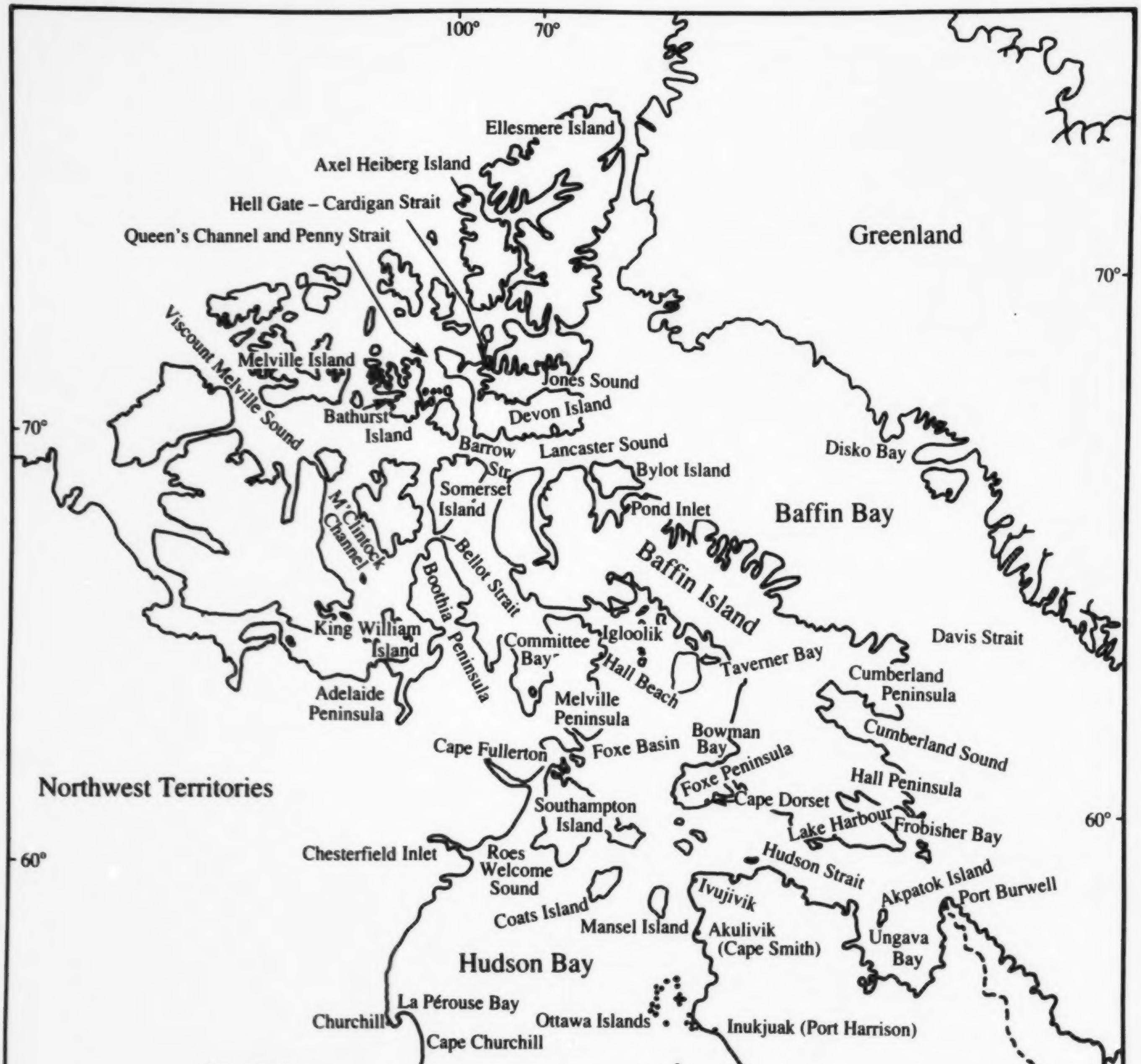
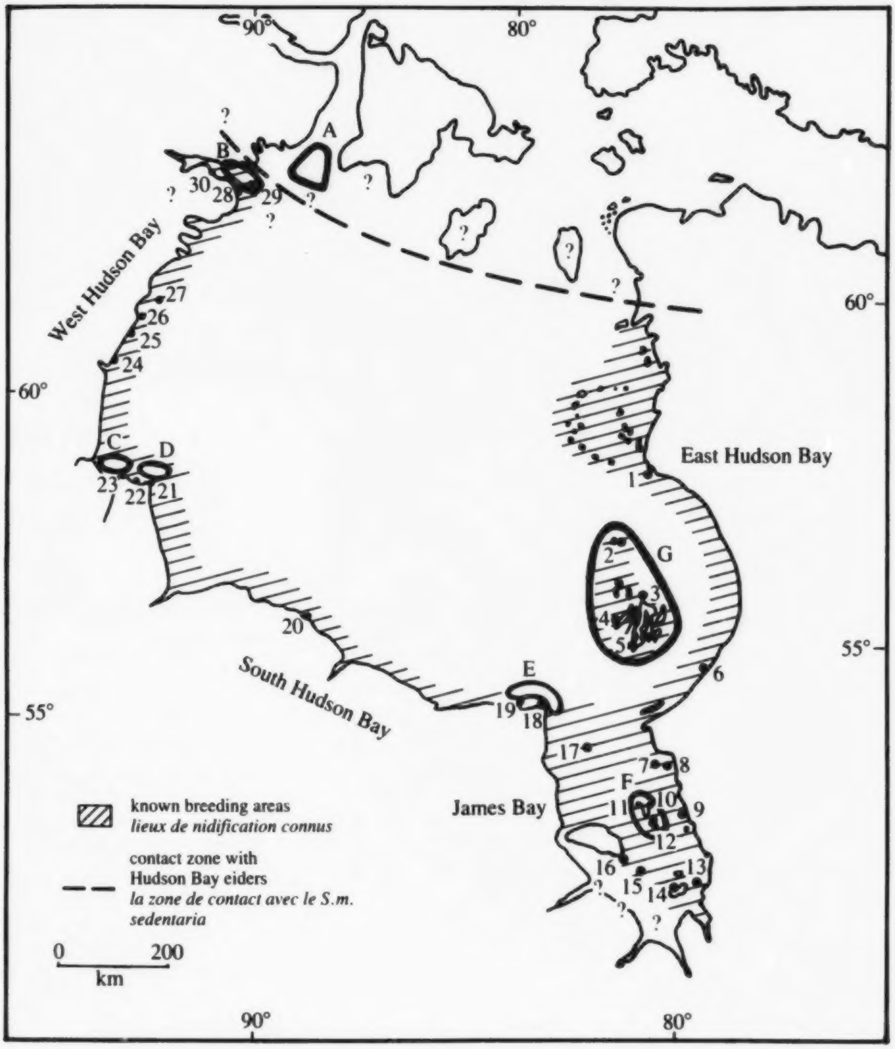

100°
70°
Ellesmere Island
Axel Heiberg Island
Hell Gate – Cardigan Strait
Queen's Channel and Penny Strait
Greenland
70°
Viscount Melville Sound
Melville Island
Jones Sound
Devon Island
Bathurst Island
70°
Barrow Str.
Lancaster Sound
Bylot Island
Disko Bay
Somerset Island
Pond Inlet
Baffin Bay
M'Clintock Channel
Bellot Strait
Baffin Island
Boothia Peninsula
King William Island
Committee Bay
Igloolik
Hall Beach
Taverner Bay
Davis Strait
Adelaide Peninsula
Melville Peninsula
Cumberland Peninsula
Cape Fullerton
Foxe Basin
Bowman Bay
Cumberland Sound
Northwest Territories
Foxe Peninsula
Hall Peninsula
Southampton Island
Cape Dorset
Lake Harbour
Frobisher Bay
60°
60°
Chesterfield Inlet
Roes Welcome Sound
Hudson Strait
Akpatok Island
Port Burwell
Coats Island
Ivujivik
Mansel Island
Akulivik (Cape Smith)
Ungava Bay
Hudson Bay
La Pérouse Bay
Churchill
Ottawa Islands
Inukjuak (Port Harrison)
Cape Churchill
Manitoba
Belcher Islands
Labrador
Cape Henrietta Maria
Pointe Louis-XIV
James Bay
0
500
km
Quebec
Ontario
100°
70°

Figure 2
Known breeding areas of the Hudson Bay Eider. The numerals correspond to Table 1. Areas known to be important during moult, fall, winter, and spring are encircled
Aire occupée par l'Eider à duvet (Somateria mollissima borealis). Les chiffres correspondent au tableau 1. Les endroits connus comme étant importants durant la mue, le printemps, l'hiver et l'automne sont encerclés



A — Roes Welcome Sound, a wintering area but subspecies undetermined (Sutton 1932); *B* — Chesterfield Inlet, used in spring (Höhn 1968); *C* — Churchill, used in fall, winter, and spring (Jehl and Smith 1970, Guild 1974); *D* — La Perouse Bay, used during moult and in spring (Taverner and Sutton 1934, Schmutz 1981); *E* — Cape Henrietta Maria, used during moult (?) and in winter (Manning 1952; P. Brown, pers. commun.); *F* — Twin Islands, used for moulting (?) (Manning 1981); *G* — Belcher Islands, Kidney and Marcopeet Islands, used during moult, fall, winter, and spring (Freeman 1970*a*; Manning 1976)

A — *détroit Roes Welcome, une aire d'hivernage, mais la sous-espèce n'a pas été confirmée (Sutton, 1932);* B — *Chesterfield Inlet, utilisé au printemps (Höhn, 1968);* C — *Churchill, utilisé à l'automne, en hiver et au printemps (Jehl et Smith, 1970; Guild, 1974);* D — *baie de la Pérouse, utilisée durant la mue et au printemps (Taverner et Sutton, 1934; Schmutz, 1981);* E — *cap Henrietta Maria, utilisé durant la mue (?) et en hiver (Manning, 1952; P. Brown, comm. pers.):* F — *îles Twin, utilisées pendant la mue (?) (Manning, 1981);* G — *îles Belchers, Kidney et Marcopeet, utilisées durant la mue, l'automne, l'hiver et le printemps (Freeman, 1970a; Manning, 1976)*

Coates, and Mansel Islands is usually cited as *borealis* (Palmer 1976) but *sedentaria* may also occur. Likewise, the identity of eiders wintering in the area (Roes Welcome Sound) has not been established, although Manning (in Bray 1943) speculated that they were *sedentaria*.

5.2. Nesting

5.2.1. Distribution ☐

Significant numbers of nests have been reported in four areas: the Churchill, Manitoba region; the islands of James Bay; the Belcher Islands; and the west Hudson Bay coast (Tables 1, 2, Fig. 2). The apparent patchiness in distribution is probably due to incomplete coverage by ornithological investigations; Hudson Bay Eiders undoubtedly nest along most of the Hudson Bay coast of Quebec (Chapdelaine, Bourget, *et al.*, this publication) and probably nest in suitable habitat along the entire western and southern Hudson Bay coast.

5.2.2. Colony size and nest density ☐

Reported nest densities varied from low (0.05 nests/ha — Savile 1951, 0.005/ha — Schmutz 1981) on mainland to intermediate and high on offshore islands (1.2/ha — Manning 1952) and islets in river deltas (1.5–2.0/ha — Schmutz 1981). Locally much higher densities occurred on some of these islets. In the La Perouse Bay area Schmutz (1981) found that 75% of nests were within 30 m of the nearest neighbour, with a modal distance between nests of 2 m. Freeman (1970*a*) found densities of 150/ha on skerries in the Belcher Islands with pockets of even higher densities (e.g., 10 nests in 20 m^2). Although these high densities occur frequently in other races of Common Eiders, nesting aggregations of *sedentaria* are generally more dispersed, and colony size smaller than in *dresseri* and *borealis*.

5.2.3. Habitat ☐

Typically, nesting concentrations occur on islands or islets in relatively shallow marine water, in large freshwater lakes near the coast, or in river deltas. Some nesting on mainland tundra has also been reported (Savile 1951, Jehl and Smith 1970, Alison 1975*a*, Schmutz 1981). Freemark (1977) and Schmutz (1981) found most nests in shrub cover (*Salix* spp., *Betula* spp.) up to 50 cm high. Freeman (1970*a*) reported nesting on islands covered by beach grass (*Elymus arenarius*), and in more exposed sites on a smooth rock islet. Nest sites are usually close to water (88% of 811 nests were within 3 m of the shore, Schmutz 1981), perhaps so that nesting females can more easily escape predators.

5.2.4. Brood-rearing ☐

Brood-rearing occurs primarily in marine habitats (Manning 1952, Manning and Coates 1952, Freeman 1970*a*, McLaren 1978), although bodies of fresh water may be used by very young broods (Guild 1974; Schmutz 1981; Abraham, unpubl.).

Amalgamation of broods or crèching (Landsborough Thomson 1964) occurs in all races of Common Eider. Crèches can include groups containing intact broods with their parents as well as groups containing the young of several families accompanied by only a few adults. For *sedentaria* the first case appears to be the norm. Schmutz (1981) reported most broods had five or fewer ducklings but more than one female attendant. McLaren (1978) reported mostly single female groups with 1 to 5 young and overall young/adult ratios between 2 and 3. Guild (1974), Freeman (1970*a*), and Savile (1951) reported ratios of 3 to 4 young per adult. Extreme crèching of the second type, such as occurs in some populations of *mollissima* (Gorman and Milne 1972) and *dresseri* (Munro and Bedard 1977), has so far not been reported for *sedentaria*.

5.3. Post-nesting

5.3.1. Moulting distribution ☐

The majority of male *sedentaria* leave their mates and depart nesting areas by mid-incubation (Guild 1974, Manning 1976, Schmutz 1981), but some may remain with groups of females late in incubation and, exceptionally, with females and young (Freeman 1970*a*; Abraham, unpubl.). Some males may moult in the general vicinity of the nesting areas (Fig. 2). In the Churchill area, particularly near La Perouse Bay, many flocks of 2–100 males and similar sized flocks of females were present on 30 June 1980. On 7 July, 300 males, in various stages of moult, were seen at Foxe Island in the same vicinity (Schmutz 1981). Males congregate in the Belcher, King George, and Sleeper Islands immediately after nesting but by August they make up less than 10% of the eiders present, suggesting that most leave to moult elsewhere (Manning 1976). Flocks of up to 100 males have been reported near various nesting locations in James Bay: Cape Henrietta Maria, Bear Island, Gasket Shoal, and Kakachischaun Point to Walrus Peninsula (Manning 1952, Manning and Coates 1952, Manning and MacPherson 1952). McLaren *et al.* (1976) reported male Common Eiders (presumably *sedentaria*) near Chesterfield Inlet in late July, and McLaren (1978) confirmed moulting there.

This fragmentary evidence suggests that moulting occurs in relatively small,

Table 1

Reported nesting locations of Hudson Bay Eiders in the eastern Canadian Arctic. Site numerals correspond to Figure 2

Lieux de nidification du Somateria mollissima sedentaria dans l'est de l'Arctique canadien. Les chiffres correspondent aux endroits numérotés en figure 2

Site *Endroit*	Name *Nom*	Evidence of breeding *Indice de reproduction*	Source *Référence*
East Hudson Bay			
1	Islands near Port Harrison	N*	Cooch 1954
2	Kidney Island and Marcopeet Island	B†	Manning 1976
3	Eskimo Harbour	N,B	Freeman 1970*a*
4	Kugong Island and nearby islands	N,B	Manning 1976
5	Robertson Bay and Kasegalik Lake and River	N,B	Freeman 1970*a*
6	Great Whale River	N	Eifrig 1906
James Bay			
7	Grey Goose Island	B	Manning and Coates 1952
8	Islands near George River	G‡	Macoun and Macoun 1909
9	Solomon's Temple Island	B	Manning and Coates 1952
10	Walter Island	N	Manning 1981
11	North Twin Island	N	Manning 1981
12	South Twin Island	B	Manning 1981
13	Strutton Island	B	Lewis and Peters 1941
14	Charlton Island	G	Smith 1943
15	Gasket Shoal	N,B	Manning and Coates 1952
16	Akimiski Island	N	Peck and James 1983
17	Bear Island	B	Manning and Coates 1952
South Hudson Bay			
18	Cape Henrietta Maria	B	Smith 1944, Manning 1952
19	Little Cape	B	D. Shepherd, pers. commun.
20	East Pen Island	N,B	Peck and James 1983
21	Cape Churchill	N,B	Taverner and Sutton 1934, Jehl and Smith 1970, Schmutz 1981
22	La Perouse Bay	N,B	Guild 1974, Cooke *et al.* 1975, Schmutz 1981, Schmutz *et al.* 1983
23	Churchill region	N	Taverner and Sutton 1934, Hawksley 1942, Jehl and Smith 1970, Alison 1975*a*, Schmutz 1981
West Hudson Bay			
24	McConnell River	G,N	Lieff 1969, Davis *et al.* 1973
25	Maguse River	G	Davis *et al.* 1973
26	Austin Island	G	Davis *et al.* 1973
27	Deadman's Island (near Marble Island)	N	A. Reed, pers. commun.
28	Mainland Chesterfield Inlet	N,B	Sutton 1931, Savile 1951, Höhn 1968
29	Islands in Chesterfield Inlet	N	Höhn 1968
30	North and south shores of Chesterfield Inlet	B	McLaren 1978

* Nests or eggs found.
† Broods or young observed.
‡ General statement of breeding.

* *Nids ou oeufs trouvés.*
† *Couvées ou canetons observés.*
‡ *Indication générale de nidification.*

scattered flocks within the breeding range, and that pronounced moult migrations are lacking, a pattern shared by some other Common Eider populations (Salomonsen 1968, Palmer 1976).

5.3.2. Fall and winter □

Information on distribution and movements of Hudson Bay Eiders in fall and winter is sparse, with most of it relating to the Belcher Islands. In September, Manning (1976) found good numbers off the west coast of the main Belcher group with males predominating. Large rafts remain on the larger bays (Eskimo Harbour, Coates Bay, Churchill Sound) until they freeze (Freeman 1970*a*). Eiders are common in fall at Churchill, the latest record being 15 November (Taverner and Sutton 1934, Jehl and Smith 1970).

As ponds, lakes, and bays freeze in early winter, the eiders move in large numbers to permanent open water west and north of the Belchers (Freeman 1970*a*). Manning (1976) reported over 2300 eiders present in late March – early April between the Belcher and Sleeper Islands. A few hundred were seen in open water 2 km east of Cape Henrietta Maria, Ontario in February 1983 (P. Brown, pers. commun.). Others winter in shore-leads along the west coast of Hudson Bay (Guild 1974). Eiders winter near Southampton Island, but their subspecific identity is not known. Sutton (1932) cites Hall's March 1865 observations of about 4000 (mostly male) "eider ducks" in Roes Welcome Sound. Manning (in Bray 1943) found eiders "still numerous" at Cape Fullerton on 20 December and reported "large numbers" in early March, "probably" *sedentaria*.

In summary, winter distribution of Hudson Bay Eiders depends upon the locations of open water (polynyas, leads, and fast-ice edges) coinciding with shallow depths (Prach *et al.* 1981, and Figure 1 in Stirling 1981). Minor variations in eider numbers at such sites must occur according to the variations in temperatures, storms, wind, and ice conditions among years (Freeman 1970*a*).

5.3.3. Spring □

Arrival at major nesting areas closely follows the appearance of open water, and thus is highly correlated with weather conditions and general seasonal phenology (Freeman 1970*a*; Schmutz 1981). The only migration reported is Freeman's (1970*a*) sighting of several flocks of 30–100 eiders daily flying northwards near the Kasegalik River, Belcher Islands. The movement probably represents dispersal from the presumed major wintering area. Spring build-ups do occur elsewhere, e.g., Churchill, where Jehl and Smith (1970) saw "hundreds" in bay ice, and near Promise Island, Chesterfield Inlet, where Höhn (1968) saw about 400 in early June. At the Belcher Islands, small numbers of eiders were noted flying over the general areas of nesting colonies in the few days immediately before open water appeared (Freeman 1970*a*) settling in soon after water became available. A similar sequence occurs at La Perouse Bay (Guild 1974, Schmutz 1981). Earlier arrival and nesting are correlated with higher mean May temperatures at La Perouse Bay. The first birds to arrive at La Perouse Bay are paired (Guild 1974, Schmutz 1981), but in the Belchers the earliest arrivals are mostly males (Manning 1976, but compare Freeman 1970*a*); the difference may be due to the Belchers' proximity to major wintering areas (hence, unpaired birds). Sex ratios were equal within 2 weeks of the arrival of the first birds (Manning 1976).

5.4. Population status □

We estimate the breeding population of Hudson Bay eiders at about 45 000 birds (Table 2). This preliminary estimate, which will serve as a working figure for verification by future field-work, has two main components: a preliminary estimate of approximately 41 600 birds (20 800 pairs) for the Hudson Bay coast of Quebec (Chapdelaine, Bourget, *et al.*, this publication) which accounts for 85% of our total estimate, and an estimate of 7400 birds for the Belcher Islands, James Bay, and the south and west coasts of Hudson Bay (Fig. 2), which accounts for the other 15% of our total.

How reasonable is our estimate of 45 200? The estimate for the east Hudson Bay coast is based on the number of adult males recorded by a breeding season aerial survey in 1978. Because no nest searches have been conducted there, the extrapolation from number of males to number of pairs was based on a comparable survey of Hudson Strait and Ungava Bay and nesting data from there (see Chapdelaine, Bourget, *et al.* for a detailed examination of the method of estimation). No equivalent survey of the rest of Hudson and James Bays has been conducted. Our estimate for these areas is based on the number of nests, broods, adults, or pairs reported from ground surveys in a few smaller areas over 30 years. This estimate may therefore be conservative, particularly for the Belcher Islands and James Bay islands. The imbalance in numbers estimated for the two regions (i.e., 85% from the Hudson Bay coast of Quebec alone, about 35% of the area), if real, is probably related to differences in available habitat. The Quebec coast has thousands of marine islands whereas the other coasts of Hudson Bay have few. These coasts do, however, have many braided streams of the type that supports 450 pairs at La Perouse Bay, Manitoba (Schmutz *et al.* 1983). The amount of permanent open water in winter (polynyas and recurring leads) may also be a factor encouraging greater use of east Hudson Bay. Recent harvest surveys (see Reed, this publication, Table 4) suggest that up to 10% of our estimated population is harvested annually in the Belcher Islands alone.

Comparisons of population status over time can be made for the Hudson Bay coast of Quebec and La Perouse Bay, Manitoba. Chapdelaine and Tremblay (1979) compared 1954 and 1978 surveys of the east coast of Hudson Bay and suggested that a decline had occurred. Continuous nesting studies at La Perouse Bay, Manitoba from 1971 to 1980 suggest that the local nesting population has remained stable or possibly increased (Cooke *et al.* 1975, Schmutz *et al.* 1983).

Table 2
Estimates of the Hudson Bay Eider population in major reported nesting areas. Sources include those in Table 1 and Chapdelaine, Bourget, *et al.* (this publication)
Estimations des populations de Somateria mollissima sedentaria pour différents secteurs. Les données proviennent de références citées au tableau 1 et Chapdelaine, Bourget et al. (présente publication)

Area *Secteur*	No. nests and broods reported *N^bre de nids et de couvées observés*	Estimated no. breeding birds* *N^bre estimé de nicheurs**
East Hudson Bay	170	41 555
James Bay	230	680–800
South Hudson Bay	469	1340–1550
West Hudson Bay	83	1425
Total	952	45 000 – 45 330

* For each site, the largest value in any single year among number of nests, pairs, author's estimate of population, or estimate based on author's density figures was used. For appropriately timed surveys or observations we assumed one pair (nest) per adult male recorded (Lock, this publication).

* *Pour chaque secteur, le plus grand nombre rapporté pour une année donnée soit de nids, soit de couvées, soit l'estimation de population ou de densité rapportée par l'auteur a été utilisé. Pour des relevés ou observations effectués en temps propice, nous avons supposé un couple (ou nid) par mâle adulte (Lock, présente publication).*

6. Northern Eiders

6.1. General distribution

The Northern Eider is a migratory subspecies of Common Eider found in the eastern Canadian Arctic and Greenland. It is the nesting subspecies of the northern Labrador coast (from about 54°N), Baffin Island, Ungava Bay, northern Hudson Bay islands (from about 63°N), and the area west to Boothia Peninsula, Somerset and Cornwallis Islands, north to Ellesmere Island, and east to Greenland (Fig. 3 and Table 3). It winters from as far north as open water persists south to the north shore and Gulf of St. Lawrence, the Maritime Provinces, and part of Maine (Palmer 1976). That part of its wintering range south of Hamilton Inlet, Labrador, is within the breeding range of the American Eider (*S. m. dresseri*).

There is a gap between the western breeding limit of the Northern Eider and the eastern limit of the Pacific Eider. In northern Hudson Bay *borealis* contacts the Hudson Bay Eider and in autumn and winter it undoubtedly mixes with the American Eider. Intergrades are discussed by Palmer (1976) and Mendall (1980, this publication).

6.2. Nesting

6.2.1. Distribution

The major nesting area of *borealis* in the Canadian Arctic centres around Hudson Strait and includes the coast of southern Baffin Island, Ungava Bay, and Southampton Island (Soper 1928, 1946; Cooch 1965, 1977; Bray 1943; MacPherson and McLaren 1959; MacLaren Atlantic 1978*b*; Abraham and Ankney, unpubl.; Gaston and Cooch, this publication; Nakashima, this publication; Chapdelaine, Bourget, *et al.*, this publication). Locations further north with appreciable numbers of nesting birds include Hell Gate – Cardigan Strait and northern Devon Island (Prach *et al.*, this publication; Hussell and Holroyd 1974), southeastern Ellesmere Island (Schledermann 1980), and probably islands in northwest Foxe Basin near Igloolik (Bray 1943) (Fig. 3, Table 3). The high arctic nesting concentrations are all located near water which is ice-free in winter or early spring (Prach *et al.* 1981 and this publication; Barry, this publication), suggesting that open water influences eider distribution in the far north. Additional polynyas with potential for eider nesting are shown in Figure 1 of Stirling (1981) and described in Smith and Rigby (1981) (see also Davis *et al.* 1974).

Table 3
Reported nesting locations of Northern Eiders in the eastern Canadian Arctic. Site numerals correspond to Figure 3
Lieux de nidification du Somateria mollissima borealis dans l'est de l'Arctique canadien. Les chiffres correspondent aux endroits numérotés en figure 3

Site *Endroit*	Name *Nom*	Evidence of breeding *Indice de reproduction*	Source *Référence*
High Arctic			
1	Flagler Bay	G*	Schledermann 1980
2	Southern Ellesmere Island	N†	Schaaning 1933
3	Truelove Lowland	N	Hussell and Holroyd 1974, Pattie 1977
4	Olsen Island	N	Duvall and Handley 1948
5	Calf Island	N	Prach *et al.*, this publication
6	Devil Island	N	Sverdrup 1904; Prach *et al.*, this publication
7	St. Helena Island, Cape Vera	N	Sverdrup 1904, Prach *et al.*, this publication
8	Resolute Bay area	G,N,B‡	Kelsall 1948, Urban 1957, Lange 1959, Geale 1971
9	Cuming Inlet	B	Eifrig 1905
10	South shore Devon Island	B§	Johnson *et al.* 1976, McLaren and McLaren 1982
Baffin Island			
11	Admiralty Inlet	G	Kemper 1976
12	Eclipse Sound, Milne Inlet	G	Soper 1928; Reed, pers. commun.
13	Pond Inlet, Bylot Island	B	Kelsall 1948, Tuck and Lemieux 1959
14	Is. in Cumberland Sound	G,N	Soper 1928, Davies (unpubl.), CWS files
15	Cornelius Grinnell Bay	N	MacLaren Marex 1979
16	Loks Land	G,B,N	MacLaren Atlantic 1978*b*; MacLaren Marex 1979; Kerbes, pers. commun.
17	Is. in Frobisher Bay	G,B	MacLaren Atlantic 1978*b*
18	Is. south coast Baffin Island (Savage Islands, Saddleback Island, etc.)	G,N	Soper 1946; Breummer, pers. commun.
19	Big Island and islands nearby	G,N	Shortt and Peters 1942, Soper 1946
20	Chorkbak Inlet	B	MacPherson and McLaren 1959
21	West Foxe Islands	N,B	Soper 1928; Cooch 1965, 1977
22	Cape Dorset area	N,B	Soper 1928; Cooch 1965, 1977
23	North coast Foxe Peninsula	B	Soper 1946
24	Bowman Bay	N	Soper 1946
25	Taverner Bay	N	Bray 1943
Foxe Basin			
26	Tern Island	G	Bray 1943
27	Igloolik Islands	N,B	Ellis and Evans 1960
28	Ooglit Island	N,B	Ellis and Evans 1960
Southampton Island area			
29	Cape Fullerton	N	Eifrig 1905
30	Boas River	G	Cooch and Barry 1957
31	Gibbon's Point	G	Bray 1943
32	Tern Islands	N	Sutton 1932
33	East Bay	N,B	Abraham and Ankney, unpubl.
34	Expectation Point	B	Parker and Ross 1973
Hudson Strait and Ungava Bay			
35	Nottingham Island, Salisbury Island area	G	Gaston and Cooch, this publication
36	Charles Island	N	Eifrig 1905
37	Several colonies in Ungava Bay	N	Chapdelaine, Bourget *et al.*, this publication
38	Payne-Bay	G	Currie 1963
39	Fort Chimo area	N,B	Gabrielson and Wright 1951
40	Whale River	G	Todd 1963
41	False River estuary	N,B	Hildebrand 1950, Driver 1958
42	Kasigiaksiavik River	N	Hildebrand 1950

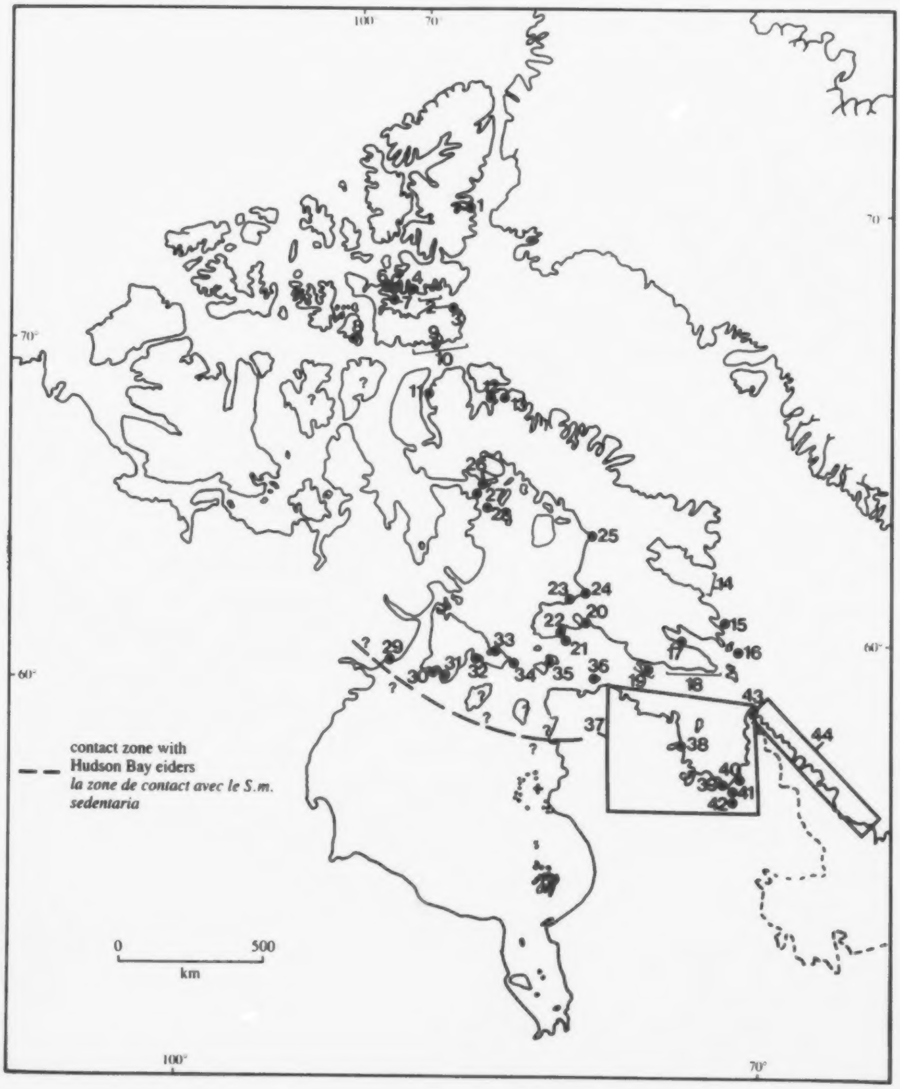
(cont'd)

Table 3 *(cont'd)*
Reported nesting locations of Northern Eiders in the eastern Canadian Arctic. Site numerals correspond to Figure 3
Lieux de nidification du Somateria mollissima borealis dans l'est de l'Arctique canadien. Les chiffres correspondent aux endroits numérotés en figure 3

Site *Endroit*	Name *Nom*	Evidence of breeding *Indice de reproduction*	Source *Référence*
Northern Labrador			
43	Button Islands	N,B	Gross 1937
44	24 colonies on northern Labrador coast	N	Lock, this publication

* General statement of breeding.	* *Indication générale de nidification.*
† Nests or eggs found.	* *Nids ou oeufs trouvés.*
‡ Broods or young observed.	‡ *Couvées ou canetons observés.*
§ At site 10, eider broods were present, but the occurrence of Northern Eiders was not confirmed.	§ *À l'endroit 10, canetons de l'eider présents mais la présence d'Eiders à duvet Somateria mollissima borealis non confirmée.*

Figure 3
Summer range (north of dashed line) and reported nesting locations of Northern Eiders. Numerals correspond to Table 3
Aire occupée par l'Eider à duvet (Somateria mollissima borealis) en été (au nord de la ligne brisée) et lieux connus de nidification. Les chiffres correspondent au tableau 3



6.2.2. Colony size and nest density □

Most Northern Eider nesting occurs in colonies ranging from a few nests to several thousand. Cooch (1965, 1977) reported totals of from 50 to 755 pairs on individual islands in the West Foxe Island group. Colonies in the Hell Gate – Cardigan Strait area had from 110 to 303 pairs (Prach *et al.*, this publication). Abraham and Ankney (unpubl.) reported 267 nests in three sample plots in different habitats on an offshore island in East Bay, Southampton Island and based on this they estimated 3770–5925 nests for the whole island. Schledermann (1980) estimated 350–400 nesting birds at the Flagler Bay polynya, Ellesmere Island. Chapdelaine, Bourget, *et al.* (this publication) report colonies as large as 158 nests in Ungava Bay. Lock (this publication) reported colonies in northern Labrador ranging from 3 to 411 pairs. Northern Eiders nesting singly or in small groups have been reported by Sutton (1932) Hildebrand (1950), Hussell and Holroyd (1974), and Prach *et al.* (this publication).

Cooch (1965) estimated 31 nests/ha on an island near Cape Dorset. Abraham and Ankney (unpubl.) calculated densities in three habitats: rocky beach (26–36 nests/ha), mixed rock–moss–*Dryas* ridge (84–131 nests/ha), and moss–sedge–*Dryas* plateau (172–272 nests/ha). In general, *borealis* seems to nest in slightly larger aggregations and at higher densities than *sedentaria*. On the other hand, most *borealis* colonies do not attain the size or extreme density of *dresseri* (e.g., Bicquette Island, Quebec has 7500 pairs [ca. 825/ha] Reed 1973, and see Bellrose 1976, p. 361).

6.2.3. Habitat

Northern Eiders nest frequently on offshore islands, to a lesser extent on islands in coastal lakes and in river deltas, and rarely at dispersed mainland locations. Coasts with abrupt shorelines or without islands have few Common Eiders (e.g., Hudson Strait from Ivujivik to Pte. Radisson, Chapdelaine, Bourget, *et al.*, this publication). Microhabitats used for nesting are diverse. Detailed descriptions can be found in Cooch (1965), Chapdelaine, Bourget, *et al.* (this publication), and Prach *et al.* (this publication).

6.2.4. Brood-rearing □

Brood-rearing by *borealis* is largely conducted in marine and intertidal waters, and fledging probably always occurs there (Palmer 1976). In general, the closer a female nests to the sea the sooner she takes her young there. Cooch (1965) and Nakashima (this publication) described the exodus of females and young from lakes on

Table 4

Sites of reported migrations of eiders in the eastern Canadian Arctic (includes only King and Northern Eiders). Site numerals correspond to Figure 5

Endroits où l'on a observé des eiders en migration dans l'est de Arctique canadien (Eider à duvet et Eider remarquable). Les chiffres en première colonne correspondent aux endroits numérotés en figure 5

Site *Endroit*	Name *Nom*	Species *Espèce*	Sex of birds *Sexe des oiseaux*	No. of birds *N^bre d'oiseaux*	Dates	Direction	Source *Référence*
1	Payne-Bay	E*,C†	—	100s	late May – early June	—	Edwards 1957
2	Frobisher Bay	E,C	♂♀	1000s	early May	—	MacLaren Marex 1979
3	Nettilling Lake	K‡	—	large flocks *grandes volées*	18 May	NW	Soper 1928
4	Butterfly River	K	♂	100s	6–22 July	—	Ellis and Evans 1960
5	Cape Searle	E	♂♀	50	27–29 May	N	Watson 1957
6	Davis Strait	K	♂	—	late spring – early sum.	—	MacLaren Atlantic 1978*a*
7	W Greenland	K	♂♀	—	March–April	N	Palmer 1976
7	W Greenland	K	♂♀	—	September	S	Salomonsen 1968
8	Baffin Bay (70°N)	K	♂	16	22 July	—	Kelsall 1948
9	Clyde Inlet	K	♂	100s	19–23 July	NE	Wynne-Edwards 1952
9	Clyde Inlet	K	♀	—	late July – early Aug.	E	Watson 1957
10	E Baffin coast	K	♂♀	—	early May	N,NW	McLaren and McLaren 1982
11	S Bylot Island coast	K	♂♀	—	27 June – 22 July	W	Drury 1961
12	Navy Board Inlet	E	♀	—	mid-August	S	Johnson *et al.* 1976
13	Arctic Bay	K	♀	8–400 flocks *volées*	early August–September	—	Renaud *et al.* 1979
14	N Baffin Island coast	K,C	♀	10 000	27 August	E	Duvall and Handley 1946
15	Cape Hay	K	♂	100s	26 June	—	Tuck and Lemieux 1959
14,15	N Baffin Island and NE Bylot Island	K,C	♀	1000s	mid-August	E	McLaren and McLaren 1982
14,15	N Baffin Island and NE Bylot Island	K,C	♂	1000s	mid–late July	E	McLaren and McLaren 1982
16	N Lancaster Sound	K	♂♀	1000s	late May – early June	W	McLaren and McLaren 1982
16	N Lancaster Sound	C	♂♀	1000s	late May – mid-June	W	McLaren and McLaren 1982
17	Coburg Island – S Devon Island	K,C	♂♀	1000s	mid-May	S	McLaren and McLaren 1982
18	Devon Island	K	♂♀	pairs	17 June	W	Harington 1961
19	Craig Harbour	K	—	large flocks *grandes volées*	early spring	WNW	Harington 1961
20	Slidre Fiord	K	♂	—	early June (none after 9 July	—	Tener 1963
21	Dundas Island, E coast	K	♂♀	340	12 June	N	Tener 1963
22	Bellot Strait	K	♂	200	10 July	E	Davis *et al.* 1974
23	Thom Bay	K	♂	—	8 August	—	Fraser 1957
24	Spence Bay	K	—	large flocks *grandes volées*	19–20 August	—	Fraser 1957
25	Adelaide Peninsula	K	♂	—	25 June – 13 July	—	MacPherson and Manning 1959
26	Chesterfield Inlet area	K	♂	—	6 July	Move to sea *Se déplace vers la mer*	Höhn 1968
27	Southampton Island, S coast	K	♂	2 large flocks *2 grandes volées*	30 April	W	Sutton 1932
27	Southampton Island, S coast	K	♂♀	1000s	8–15 May	W	Sutton 1932
28	East Bay	K	♂	450	12–20 July	ENE	Abraham and Ankney, unpubl.

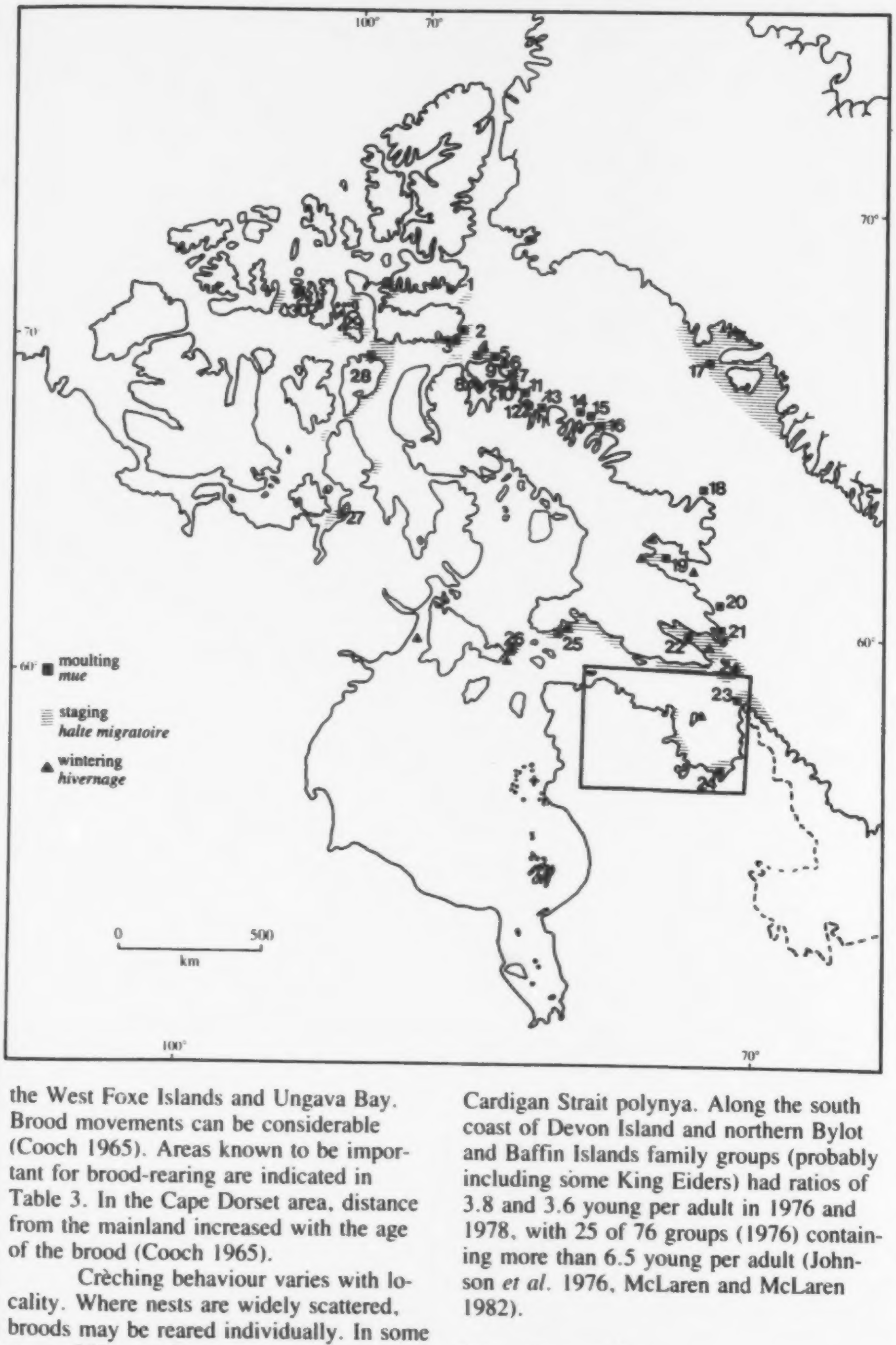
* Species not distinguished.
† Common Eiders.
‡ King Eiders.

* *Espèce non déterminée.*
† *Eider à duvet.*
‡ *Eider remarquable.*

Figure 4

Reported moulting areas (see Table 5), staging areas, and winter areas (see text) of eiders. For detailed treatment of area in rectangle see Nakashima (this publication)

Lieux connus de mue (voir tableau 5), de haltes migratoires et d'hivernage (voir texte) d'eiders. Pour une description détaillée pour le secteur à l'intérieur du rectangle, voir Nakashima (présente publication)



the West Foxe Islands and Ungava Bay. Brood movements can be considerable (Cooch 1965). Areas known to be important for brood-rearing are indicated in Table 3. In the Cape Dorset area, distance from the mainland increased with the age of the brood (Cooch 1965).

Crèching behaviour varies with locality. Where nests are widely scattered, broods may be reared individually. In some parts of Ungava Bay, groups of two to four broods are common (Nakashima, this publication). Cooch (1965) found an overall ratio of 5.5 ducklings per adult female, indicating that some parents had abandoned their offspring to communal broods (clutch size averaged 3.54). Prach *et al.* (this publication) found an average of 2.1 ducklings per female in 45 groups at Hell Gate – Cardigan Strait polynya. Along the south coast of Devon Island and northern Bylot and Baffin Islands family groups (probably including some King Eiders) had ratios of 3.8 and 3.6 young per adult in 1976 and 1978, with 25 of 76 groups (1976) containing more than 6.5 young per adult (Johnson *et al.* 1976, McLaren and McLaren 1982).

6.3. Post-nesting

6.3.1. Moult migration and moult distribution □

McLaren and McLaren (1982) and Nakashima (this publication) have described migrations of eiders in midsummer. Table 4 summarizes available data. Salomonsen (1968) and Palmer (1976) thought that the majority of Canadian-breeding *borealis* migrated to southwestern Greenland to moult; however, reports from Inuit hunters (Nakashima, this publication) establish the importance of certain regions of Ungava Bay as moulting areas, especially for males (see also Edwards 1957, Driver 1958). Males congregate in other eastern arctic localities in early July: southern Baffin Island (Soper 1946, MacPherson and McLaren 1959), southeastern Baffin Island (MacLaren Atlantic 1978*b*, MacLaren Marex 1979), Southampton Island (Sutton 1932), and eastern Lancaster Sound (McLaren and McLaren 1982). At least some of the birds that assemble near southeastern Baffin Island and eastern Lancaster Sound remain to moult. Other, apparently less important, moulting areas include northern Labrador (Gross 1937) and Barlow Inlet, Cornwallis Island (Davis *et al.* 1974). Some females undoubtedly moult near their nesting areas. Figure 4 and Table 5 give details of moulting areas.

6.3.2. Fall and winter □

Rafts of females and young persist near nesting areas late into September (Sutton 1932, MacPherson and McLaren 1959, Johnson *et al.* 1976, MacLaren Atlantic 1978*b*). Eiders have been reported as late as mid-October in eastern Lancaster Sound (McLaren and McLaren 1982), Pangnirtung Fiord (Soper 1928), Dorset Harbour (MacPherson and McLaren 1959), and northwest of Hall Peninsula (MacLaren Atlantic 1978*b*). The most important areas from November on are southeastern Baffin Island and northern Labrador, and MacLaren Marex (1979) describe changes in numbers there throughout fall. Nakashima (this publication) provides details of fall migration in Ungava Bay.

A very small proportion of Northern Eiders probably winter in the eastern Canadian Arctic (Fig. 4); most winter in southwestern Greenland and eastern North America, particularly Newfoundland and the Gulf of St. Lawrence (Gillespie and Learning 1974; Bourget *et al.*, this publication). The main arctic wintering locations are southeastern Baffin Island and the northern tip of Labrador where the tidal range and currents create recurring polynyas and shore-leads. In March, over 4000 eiders (including Common Eiders) were counted there; some also occurred in Ungava Bay along the east coast of Akpatok Island and the coasts of other islands in eastern Hudson Strait (MacLaren Marex 1979). The Inuit of northern Quebec report eiders overwintering near the northern tip of Labrador, in Hudson Strait, and in Ungava Bay, at least some of which are believed to be Common Eiders (Nakashima, this publication).

Table 5

Reported moulting areas for Northern and King Eiders in the eastern Canadian Arctic (does not include nesting areas [Figs. 3, 6] where some females undoubtedly moult). Site numerals correspond to Figure 4

Endroits où l'on a observé des Eiders à duvet et des Eiders remarquables en mue dans l'est de l'Arctique canadien (n'incluant pas des lieux de nidification — figures 3 et 6 — où certaines femelles muent). Les chiffres en première colonne correspondent aux endroits numérotés en figure 4

Site *Endroit*	Name *Nom*	Species *Espèces*	Sex of birds *Sexe des oiseaux*	No. of birds* *N^{bre} d'oiseaux*	Source *Référence*
1	Ellesmere Island, SE coast	E†	♂♀	175	McLaren and McLaren 1982
2	Devon Island, SE coast	E	♂♀	25	McLaren and McLaren 1982
3	Devon Island, SE coast	E	♂♀	820	McLaren and McLaren 1982
4	Bylot Island, N coast	E	♂♀	100	McLaren and McLaren 1982
5	Bylot Island, NE coast	E	♂♀	35	McLaren and McLaren 1982
6	Bylot Island, NE coast	E	♂♀	75	McLaren and McLaren 1982
7	Cape Hay	E	♂♀	250	McLaren and McLaren 1982
8	Bylot Island, SW coast	E	♂♀	355	McLaren and McLaren 1982
9	Bylot Island, S coast	E	♂♀	400	McLaren and McLaren 1982
10	Baffin Island, N coast	E	♂♀	200	McLaren and McLaren 1982
11	Baffin Island, N coast	E	♂♀	349	McLaren and McLaren 1982
12	Baffin Island, N coast	E	♂♀	20	McLaren and McLaren 1982
13	Baffin Island, N coast	E	♂♀	100	McLaren and McLaren 1982
14	Head of Eglinton Fiord	K‡	♀(10♂)	1500–2000	Dalgety 1936
15	Cape Eglinton	K	♀(3♂)	1000	Dalgety 1936
16	Head of Clyde Inlet	K	♀	large flocks *grandes volées*	Dalgety 1936
17	Disko Bay, Greenland	K	♂	100 000	Salomonsen 1968, 1979
18	Padloping Island	C§	♂	50+	Wynne-Edwards 1952
19	Cumberland Sound	K	♂	many *beaucoup*	Bent 1962, MacLaren Atlantic 1978*b*
20	SE Baffin Island	C	—	1	Sutton and Parmalee 1956
21	SE Hall Peninsula	C	♂♀	3758	MacLaren Marex 1979
22	Frobisher Bay	C	♂♀	1242	MacLaren Atlantic 1978*a*, 1978*b*; MacLaren Marex 1979
23	Is. between Port Burwell and Cape Chidley	C	♂♀	flocks of up to 30 *volées jusqu'à 30*	Gross 1937, MacLaren Marex 1979
24	False River Estuary	K,C	—	2000(?)	Driver 1958
25	Neta Island	C	—	20	MacPherson and McLaren 1959
26	Seahorse Point	C	♂	—	Sutton 1932
27	Rasmussen Basin Lowland	K	♀	160	McLaren *et al.* 1977
28	Garnier Bay	E	♀	—	Davis *et al.* 1974
29	Barlow Inlet	E,C	♂(C),♀(E)	330	Davis *et al.* 1974
30	Bracebridge Inlet	K	♀	—	Palmer 1976

* Maximum count or estimate from a single survey if more than one available.

† Species not distinguished. For sites 1–13 a total is given: in 1976, 278K, 117C, and 1792E; in 1978, 323K, 10C, and 2019E. Some eiders may have been present on more than one survey, see McLaren and McLaren (1982).

‡ King Eiders.

§ Common Eiders.

* *Dénombrement ou estimation maximal provenant d'un seul relevé lorsqu'il en existe plus qu'un.*

† *Espèce non déterminée. Pour les endroits 1 à 13, on indique un total: en 1976, 278K, 117C et 1792E; en 1978, 323K, 10C et 2019E. Quelques eiders ont peut-être été présents lors de plus d'un relevé, voir McLaren et McLaren (1982).*

‡ *Eider remarquable.*

§ *Eider à duvet.*

6.3.3. Spring

The return of Northern Eiders begins in late April and early May. MacLaren Marex (1979) describe movements into southeastern Baffin Island, McLaren and McLaren (1982) and Johnson *et al.* (1976) describe those through Lancaster Sound, and Nakashima (this publication) discusses those into Ungava Bay. Soper (1928, 1946), MacPherson and MacLaren (1959), and Cooch (1965) detail eider activity in spring along southern Baffin Island near Cape Dorset.

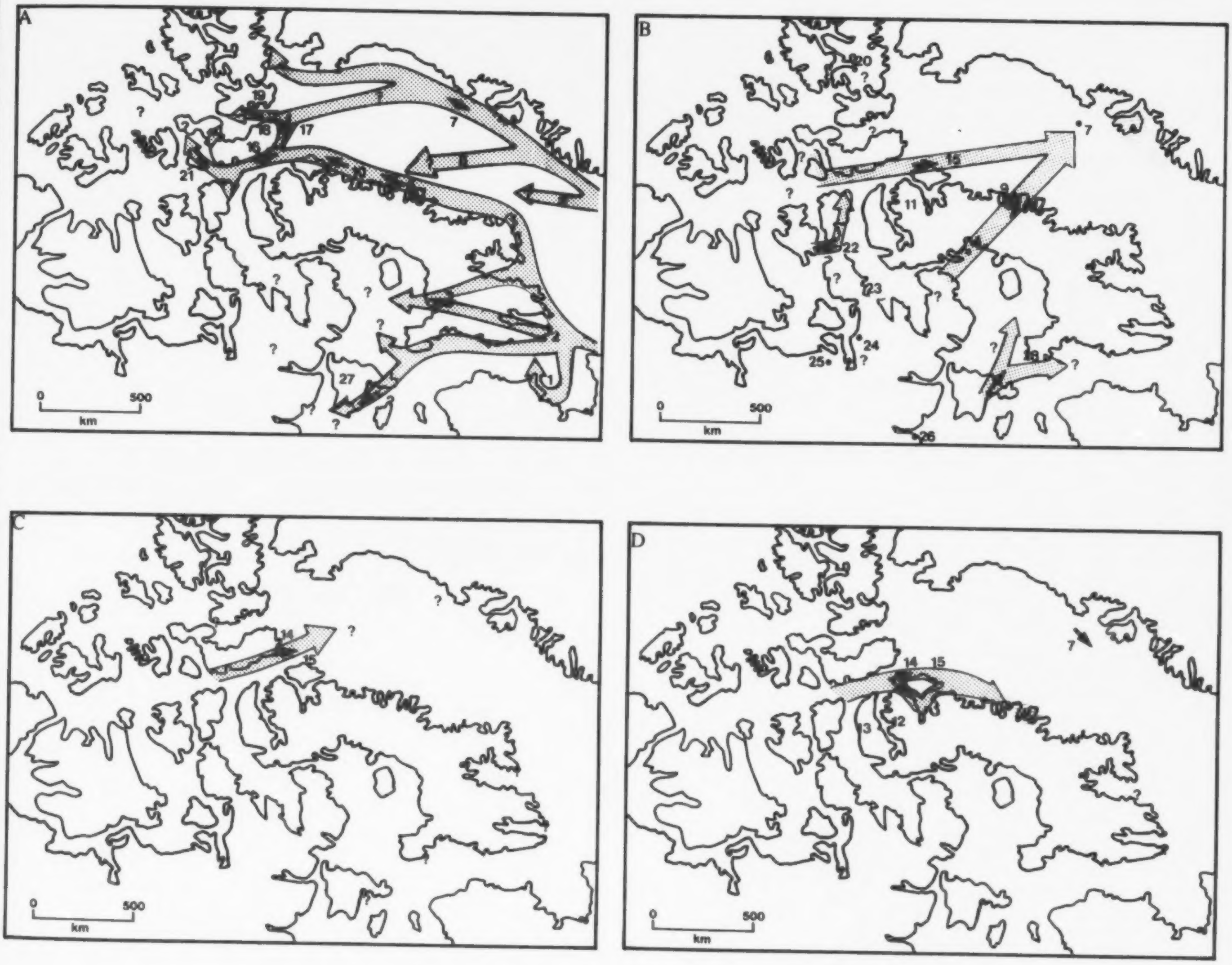
In coastal habitats of southeastern Baffin Island, northern Labrador, and eastern Hudson Strait, peak numbers were found in early May (over 25 000) (MacLaren Marex 1979). These eiders probably moved up the Labrador coast from wintering areas in Newfoundland and the Gulf of St. Lawrence. Large numbers reached the southern Foxe Peninsula coast by mid-May and arrived at northern Hudson Bay locations in late May to early June (Sutton 1932).

On northern Baffin Island and in eastern Lancaster Sound the first individuals arrive in late April and early May, with peak numbers in late May to early June. An abrupt decline in numbers around Coburg Island in late May and an increase along the southern Devon Island coast suggested a southward movement to nesting areas further west (McLaren and McLaren 1982). These birds likely came from southwestern Greenland wintering areas after following the west coast north to some crossing point in northern Baffin Bay. Movement to nesting areas occurs in early June, although some arrive at nearby polynyas as early as mid-April (Prach *et al.*, this publication). Distribution and movements of *borealis* into the central Arctic in spring is greatly affected by ice conditions (Alliston *et al.* 1976). The coasts of south-

Figure 5

Migration routes of Northern and King Eiders of the eastern Canadian Arctic. Numerals and small arrows correspond to Table 4. For further details on Ungava Bay see Nakashima (this publication)

Routes de migration de l'Eider à duvet (Somateria mollissima borealis) et de l'Eider remarquable de l'est de l'Arctique canadien. Les chiffres et les petites flèches correspondent au tableau 4. Pour plus de détails pour la baie d'Ungava, voir Nakashima (présente publication)



A — spring migration (mostly King Eiders, both sexes); *B* — summer moult migrations of adult male King Eiders; *C* — summer moult migrations of adult male Northern Eiders; *D* —summer (moult) and fall migrations of females, both species

A — migration printanière (principalement l'Eider remarquable, les deux sexes); B — migration estivale pour la mue, mâles adultes, Eider remarquable; C — migration estivale pour la mue, mâles adultes, Eider à duvet; D — migration estivale (mue) et automnale des femelles, les deux espèces west Devon Island, south Cornwallis Island and northern Somerset Island are the major staging areas and migration corridors (Fig. 5) with the north side of Barrow Strait being relatively more important. Jones Sound is a probable route for some eiders nesting near Hell Gate – Cardigan Strait polynya (Prach *et al.*, this publication). Polynyas at Queen's Channel and Penny Strait were especially important to eiders in the "late" spring of 1974 (Davis *et al.* 1974).

From such pre-nesting staging areas, eiders finally disperse to nesting locations. Throughout the migration and spring staging period they use coastal habitats, a distribution that probably reflects benthic foraging techniques and the need, particularly for females, to acquire and maintain nutrient reserves in anticipation of the incubation period fast (Korschgen 1977).

6.4. Population status

Estimates of the number of Northern Eiders in various portions of their Canadian breeding range are given in Table 6. From these we estimate a total population of at least 92 150 pairs (184 300 birds). Our estimate is likely low because some large areas have not been thoroughly investigated and we made no adjustments for these areas. The majority of nesting birds are found along the coasts of southern Baffin Island, northern Quebec, Ungava Bay, Hudson Strait, and northern Labrador (Chapdelaine, Bourget, *et al.*, this publication; Gaston and Cooch, this publication; Lock, this publication). The area north of Lancaster Sound has not been well explored. Most of the estimated total for that area comes from the colonies associated with the Flagler Bay and Hell Gate – Cardigan Strait polynyas (Schledermann 1980; Prach *et al.*, this publication) but other as-yet-undiscovered breeding areas could harbour more eiders. The Foxe Basin total is clearly inadequate because large but unquantified colonies have been reported near Igloolik (Bray 1943, Ellis and Evans 1960) and appreciable harvests of eggs and adults occur there (see Reed, this publication).

Bellrose (1976, p. 356) speculated that there were 1.5 to 2 million Common Eiders in North America but gave no estimate of the proportion that were *borealis*. Tuck (pers. commun. cited in Gillespie and Learning 1974) speculated that 2 million eiders wintered in Newfoundland waters; a large proportion of them are thought to be *borealis*. However, no previous estimates of the Canadian-breeding *borealis* population have been attempted.

St. Helena Island in Hell Gate – Cardigan Strait north of Devon Island
L'île St. Helena, dans le détroit Hell Gate – Cardigan, au nord de l'île Devon
(photo: A. Dzubin)

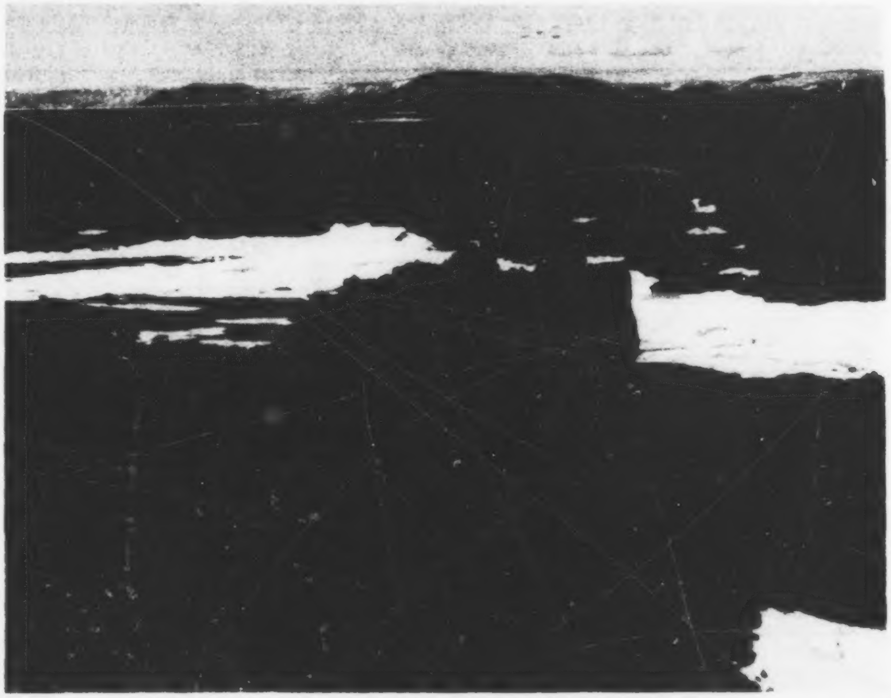


Table 6
Estimates of the Northern Eider populations in major reported nesting areas.* Sources include those listed in Table 3
Estimations des populations de Somateria mollissima borealis pour différents secteurs. Les données proviennent de références citées au tableau 3

Area *Secteur*	No. nests and broods reported *N^{bre} de nids et couvées observés*	Estimated no. breeding birds *N^{bre} estimé de nicheurs*
High Arctic Islands	569	2330–2380
Baffin Island		
South coast	(1298)?	48 000
East coast	777	5000–5500
North coast	20	40
Foxe Basin	no numbers given *aucun chiffre disponible*	60
Southampton Island area	279	8360 – 12 675
Northern Quebec and Ungava Bay	4814	99 060 ± 20 800
Northern Labrador coast	2021	19 020
Total	9778	181 870 – 186 735

*Same methods as in Table 2. * *Selon les méthodes indiquées au tableau 2.*

Table 7
Reported nesting locations of King Eiders in the eastern Canadian Arctic. Site numerals correspond to Figure 6
Lieux de nidification de l'Eider remarquable dans l'est de l'Arctique canadien. Les chiffres correspondent aux endroits numérotés en figure 6

Site *Endroit*	Name *Nom*	Evidence of breeding *Indice de reproduction*	Source *Référence*
Ellesmere and Axel Heiberg Islands			
1	Floeberg Beach	N*	Fielden 1877
2	Hazen Lake	N,B†	Savile and Oliver 1964, Corbet and Downe 1966
3	Slidre Fiord (inland)	G‡	Parmelee and MacDonald 1960, Waterston and Waterston 1972
4	Eureka	B	Duvall and Handley 1948, Parmelee and MacDonald 1960
5	Slidre Fiord	B	Parmelee and MacDonald 1960
Devon Island			
6	Cape Newman Smith	N	Harington 1961
7	Truelove Lowland	N,B	Hussell and Holroyd 1974
Baffin Island and Foxe Basin			
8	Arctic Bay	B	Ellis 1956, Renaud *et al.* 1979
9	Navy Board Inlet	G	Tuck and Lemieux 1959
10	Cape Hay	B	Tuck and Lemieux 1959
11	Clyde Inlet	B	Dalgety 1936
12	Butterfly Lake	N or B	Ellis and Evans 1960
13	Frustration Bay	N or B	Ellis and Evans 1960
14	Igloolik Islands	N or B	Ellis and Evans 1960
15	Hooper Inlet	G	Bray 1943
16	Crozier River	G	Bray 1943
17	SW Prince Charles Island	N or B	Ellis and Evans 1960
18	Taverner Bay	G	Bray 1943
19	Nettilling Lake	G,B	Soper 1928
20	Bowman Bay	N,B	Soper 1940, 1946
21	Nuwata District, Foxe Peninsula	G	Soper 1946
22	Cape Queen	B	MacPherson and McLaren 1959
Hudson Strait and Ungava Bay			
23	Stupart Bay	G	Todd 1963, MacLaren Atlantic 1977
24	False River	B	Driver 1958
Hudson Bay			
25	Kogaluk River	N	Todd 1963
26	Kidney Island	B	Manning 1976
27	North Belcher Islands	G	Freeman 1970*b*
28	Kugong Island	G	Manning 1976
29	South Twin Island	G,B	Manning and Coates 1952
30	Cape Henrietta Maria	G,B	Smith 1944, Manning 1952
31	Little Cape	B	D. Shepherd, pers. commun.
32	La Perouse Bay	N	Abraham and Cooke 1979
33	McConnell River	G	Alison 1975*b*
34	Chesterfield Inlet	G,N	Sutton 1931, Savile 1951, Höhn 1968
Southampton Island			
35	Bay of God's Mercy	G	Bray 1943, Cooch and Barry 1957
36	Salmon Pond	B	Parker and Ross 1973
37	Cape Low	B	Sutton 1932
38	Coral Harbour	B	Sutton 1932
39	Prairie Point	G	Sutton 1932
40	East Bay	N,G	Abraham and Ankney, unpubl.; Cooch and Barry 1957
41	Duke of York Bay	B	Parker and Ross 1973
42	Is. in Frozen Strait	G	Bray 1943
Queen Maud Gulf§			
43	Jenny Lind Island	B	Parmelee *et al.* 1967
44	Laine Lake	G,B	Gavin 1947, Aleksiuk 1964
45	Arlone Lake	G	Aleksiuk 1964
46	Karak Lake	G	Ryder 1971

(cont'd)

7. King Eiders

7.1. General distribution □

King Eiders are found throughout most of the eastern Arctic in summer (Fig. 6 and Table 7). They are regular but not common in Hudson Bay south of about 63°N and, in the High Arctic, they apparently do not occur on the central Queen Elizabeth Islands. Palmer (1976) indicated that King Eiders were most abundant as nesters in the western Arctic and that portion of the eastern Arctic from Prince of Wales and Somerset Islands to Southampton Island. The primary wintering areas of eastern arctic kings are marine waters off southwestern Greenland and eastern North America, particularly Newfoundland south to Maine. Some King Eiders winter in the eastern Canadian Arctic.

7.2. Nesting

7.2.1. Distribution □

Reported nesting locations of King Eiders are more numerous than for either subspecies of Common Eider, probably a result of dispersed mainland nesting habits. Known breeding locations are concentrated in the westernmost portion of the area covered here (Fig. 6), particularly the Boothia Peninsula (Fraser 1957, Davis *et al.* 1974) and Southampton Island (Sutton 1932, Bray 1943, Parker and Ross 1973). They are also relatively common nesters along the coasts of Foxe Basin (Bray 1943; Ellis and Evans 1960). Small numbers nest in lower Hudson Bay (Alison 1975*b*; Manning 1976; Abraham and Cooke 1979; H. G. Lumsden and D. Shepherd, pers. commun.). Those of Melville and Prince Patrick Islands (Maltby 1976, 1978; MacDonald 1954) may belong to the western Canadian arctic population (Barry, this publication).

7.2.2. Density □

Unlike Common Eiders, King Eiders are not usually colonial, hence nests are far apart and densities are low. In the Rasmussen Basin nest densities were highest along the coast and decreased progressively inland (McLaren *et al.* 1977), but such a trend is not general. Lamothe (1973) reported a total of only 30 nests in 5 years in a 4-km^2 study area on Bathurst Island, a density of 1–3.5/km^2. Similar densities were reported for Bowman Bay, Baffin Island (Soper 1946), and Adelaide Peninsula (MacPherson and Manning 1959). Densities of 5–10/km^2 were found at East Bay, Southampton Island (Abraham and Ankney, unpubl.). On a rocky islet at the head of East Bay, seven nests were found in a 3 × 5 m area. Parmelee *et al.* (1967) also found that King Eiders sometimes nest colonially on small islands.

7.2.3. Habitat □

King Eiders nest in a variety of tundra habitats, but drier, well-drained habitats may predominate as nest sites. Distance of nests from water varies greatly, e.g., 10–2100 m (average ca. 500 m) for 41 nests (Lamothe 1973). This variation epitomizes the qualitative assessments of Sutton (1932), Bray (1943), and Parmelee *et al.* (1967). Some nesting also occurs on coastal barrier islands (Schamel 1977), islands in lakes (Soper 1928), and islands among tidal flats (Bray 1943).

7.2.4. Brood-rearing □

King Eiders make use of both fresh water (14 of 20 reports) and salt water (8 of 20 reports) for brood-rearing. Parmelee *et al.* (1967) marked females and discovered that they moved their families away from nest ponds and were replaced by other families. There was a continual movement among ponds (noted also by Savile and Oliver 1964; Abraham and Ankney, unpubl.) and the movement was directional in that families eventually moved to sea, where fledging occurs (Sutton 1932, Parmelee *et al.* 1967).

Although King Eiders are usually solitary nesters spread widely over suitable habitat, they exhibit the same tendency to form multi-family groups for brood-rearing that characterizes other eiders and many sea-duck species. Reported number of young per female ranges from 1.7 to 5.7 (average about 3.7) for nearly 100 groups (Parmelee *et al.* 1967; Parker and Ross 1973; Reed and Dupuis, pers. commun.; Abraham and Ankney, unpubl.). Groups of up to 150 individuals occur.

7.3. Post-nesting

7.3.1. Moult migration and moult distribution □

The conspicuous post-breeding exodus of male King Eiders from the Canadian Arctic has drawn sufficient attention that the major routes, timing and principal destinations are quite well documented (Fig. 5, Table 4). Salomonsen's (1968) initial account has been supplemented with details from recent studies. Males from the entire area covered in this paper may migrate east to the principal moulting area centered on Disko Bay, Greenland. Some birds from the King William Island – Adelaide Peninsula region may migrate to western moulting and wintering areas while others go east (Salomonsen 1979). Probable migration routes are Lancaster Sound (McLaren and McLaren 1982), overland central Baffin Island (Wynne-Edwards 1952), and Hudson and Davis Straits (Salomonsen 1968).

Timing of the male moult migration varies among years, but desertion of females usually occurs in late June to mid-July (Sutton 1932, Bray 1943, MacPherson and Manning 1959, Davis *et al.* 1974, McLaren *et al.* 1977). McLaren and McLaren (1982) describe eastward passage through Lancaster Sound, primarily along the south shore; the proportion of males increased after about 10 July and movement continued until mid-August. Ellis and Evans (1960) described concentrations of males in northern Foxe Basin from early to mid-July which dispersed by the end of July, presumably using the Baffin Island overland route; this timing agrees with Wynne-Edwards' (1952) and Watson's (1957) observations of male migrations over east-central Baffin Island. Large numbers collect in west Greenland in the last half of July with peak numbers in early August (Salomonsen 1968). There are a few moult areas in the Canadian Arctic (Fig. 4).

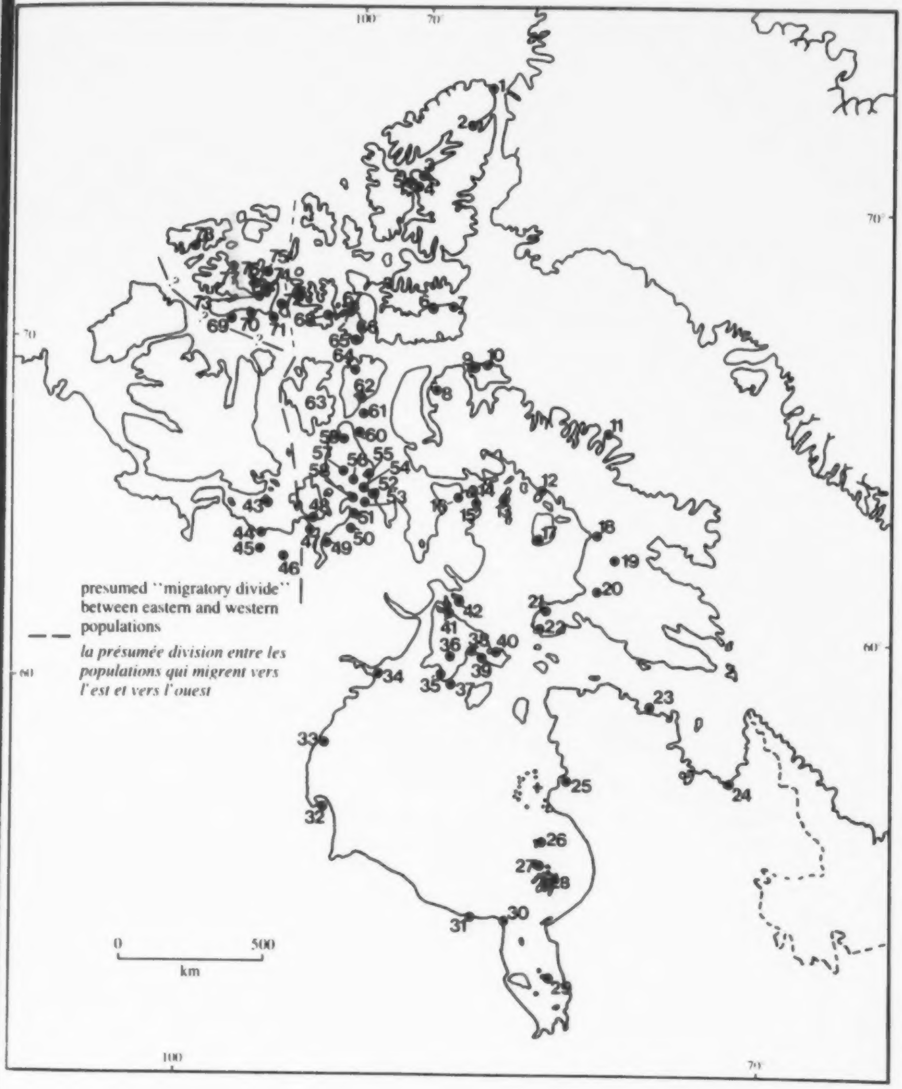
Table 7 *(cont'd)*
Reported nesting locations of King Eiders in the eastern Canadian Arctic. Site numerals correspond to Figure 6
Lieux de nidification de l'Eider remarquable dans l'est de l'Arctique canadien. Les chiffres correspondent aux endroits numérotés en figure 6

Site *Endroit*	Name *Nom*	Evidence of breeding *Indice de reproduction*	Source *Référence*
King William Island Area§			
47	Adelaide Peninsula	B	MacPherson and Manning 1959
48	Simpson Strait area	N	Fraser 1957
49	Chantrey Inlet	G	McLaren *et al.* 1976, 1977
50 51	Inglis River, Rasmussen Basin	N,B	McLaren *et al.* 1976, 1977
Boothia Peninsula			
52	Imilik Island	B	Fraser 1957
53	Redfish Lake	G	Fraser 1957
54	Spence Bay	G,B	Ellis 1956, Fraser 1957
55	Thom Bay	B	Fraser 1957
56	Lake Jekyll	N	Fraser 1957
57	Kanikjuke Lake	B	Fraser 1957
58	Sagvak Inlet	B	Fraser 1957
59	Wrottesley River	N	Davis *et al.* 1974
60	Wilson Bay	N	Davis *et al.* 1974
Somerset and Prince of Wales Islands			
61	Cape Garry	B‖	Davis *et al.* 1974
62	Creswell Bay	N	Alliston *et al.* 1976
63	Prince of Wales Island	N	Lamothe 1973, Davis *et al.* 1974
64	Aston Bay	B	Alliston *et al.* 1976
Cornwallis and Bathurst Island			
65	Resolute Bay	B	Kelsall 1948
66	Cornwallis Island area	G,B	Alliston *et al.* 1976
67	Little Cornwallis Island	G,B	Alliston *et al.* 1976
68	Bathurst Island§	N,B	Lamothe 1973
Melville and Prince Patrick Islands§			
69	Winter Harbour	B	Maltby 1978
70	Dealy Island	B	Finney and Prevett, unpubl.
71	Little Point	N,B	Maltby 1978
72	King Point	N,B	Maltby 1976, 1978
73	Sabine Lowlands	G‖	Alliston *et al.* 1976
74	Sherard Bay	B	Maltby 1978
75	Sabine Peninsula	B	Maltby 1978
76	Eldridge Bay	B	Maltby 1978
	NW Melville Island	B	Maltby 1978
78	Mould Bay	B	MacDonald 1954

*Nests or eggs found.
†Broods or young observed.
‡General statement of breeding.
§Eiders from these areas may migrate westwards (see Barry, this publication).
‖Specific identity of broods not established, could have been Common Eiders.

* *Nids ou oeufs trouvés.*
† *Couvées ou canetons observés.*
‡ *Indication générale de nidification.*
§ *Les eiders de ces régions peuvent migrer à l'ouest (voir Barry, présente publication).*
‖ *L'identification exacte des couvées n'a pas été établie, pourraient être des Eiders à duvet.*

Figure 6
Summer range and reported nesting locations of King Eiders in the eastern Canadian Arctic. Numerals correspond to Table 7
Aire occupée par l'Eider remarquable en été et lieux de nidification dans l'est de l'Arctique canadien. Les chiffres correspondent au tableau 7


100°
70°
70°
70°
60°
60°
100
70°
presumed "migratory divide" between eastern and western populations
la présumée division entre les populations qui migrent vers l'est et vers l'ouest
0
500
km

Females follow a different pattern. Some moult at nesting areas while accompanying young (Alliston *et al.* 1976), but a large number migrate to moulting areas in eastern Baffin Island (Dalgety 1936, Salomonsen 1979). Females staged along the east coast of Somerset Island in August 1974 and 1975 (in much greater numbers in the poor nesting year of 1974) (Davis *et al.* 1974; Alliston *et al.* 1976). Duvall and Handley (1946) and McLaren and McLaren (1982) reported between 10 000 and 25 000 females in mid- to late August (presumed to include both King and Common Eiders) passing along northern Baffin Bay and through Lancaster Sound.

7.3.2. Fall and winter □

Records from Melville Island, Ellesmere Island, and northern Greenland indicate that most King Eiders leave by early September (Bernier 1910, Parmelee and MacDonald 1960). They remain in the Rasmussen Basin area and Southampton Island through September (Fraser 1957, MacPherson and Manning 1959, Sutton 1932). The fragmentary data available indicate that the main eastward migration of females with young occurs from mid-September to mid-October along the major routes used in spring (Soper 1946, Johnson *et al.* 1976, McLaren and McLaren 1982). Records in November are rare and usually of single birds (Soper 1928, Sutton 1932, Todd 1963). Males have rarely been recorded in fall (MacPherson and McLaren 1959).

A few King Eiders probably winter with Northern Eiders in eastern arctic polynyas. There are January records from Southampton Island (Sutton 1932) and (possibly) from eastern Baffin Island (Soper 1928), and some are reported to overwinter in Hudson Strait and northern Labrador (Nakashima, this publication). Suggestions of probable wintering in the eastern Arctic come principally from March records in southern and southeastern Baffin Island and northern Labrador (Soper 1946, MacLaren Marex 1979). The primary wintering areas are along the Atlantic coast from Newfoundland south to Maine, and the southwestern coast of Greenland. A few individuals show up regularly on the Great Lakes and the St. Lawrence River east to Montreal (Alison 1975*b*; Bellrose 1976, p. 368; David 1980).

7.3.3. Spring □

Spring migration of King Eiders returning to eastern arctic breeding areas is not well documented (Palmer 1976; Fig. 5, Table 4). Departure from the most southerly wintering areas begins in March, and April is a month of widespread movement. There seem to be three major travel routes into the eastern Arctic: one from south western Greenland along the coast to Baffin Bay and then across to eastern Lancaster Sound (McLaren and McLaren 1982, Salomonsen 1950); a second one from Newfoundland, Labrador, and southeastern Baffin Island along the east Baffin coast to Bylot Island and eastern Lancaster Sound (McLaren and McLaren 1982); and a third via Hudson Strait along both shores but especially the southern Baffin Island coast (Palmer 1976, MacPherson and McLaren 1959, Edwards 1957). McLaren and McLaren (1982) suggest that some King Eiders migrating along the east Baffin coast may have come from southwest Greenland; MacLaren Atlantic's (1978*a*) observation of males crossing Davis Strait in late spring support this.

Along the southern route, males dominate in early stages of migration and the proportion of females increases by late April. Numbers remain high along the south Baffin shore through mid-May then decline abruptly. Sutton's (1932) observations on arrival and movements near Southampton Island fit well with Baffin Island data suggesting that nesters from there and perhaps Melville Peninsula and Rasmussen Basin use the Hudson Strait route. Availability of open water undoubtedly influences timing and local distribution, and observations on this route coincide with known polynyas and leads (Stirling 1981, Prach *et al.* 1981).

Events in Lancaster Sound occur about 2 weeks later (McLaren and McLaren 1982). Birds are common at the eastern end by early May, apparently arriving via Greenland and Baffin Bay. Numbers increase throughout May. Birds arriving by the east Baffin route frequent most of the coastline north of Pond Inlet by late May (Ellis 1956, Tuck and Lemieux 1959). Movement through the sound occurs in late May and early June as birds move to nesting areas further north and west (Harrington 1961, Hussell and Holroyd 1974, Davis *et al.* 1974). King Eiders are common along both shores of Barrow Strait in early June (Davis *et al.* 1974, Alliston *et al.* 1976). Those birds using the north side are probably destined for nesting areas on Cornwallis, Bathurst, and Melville Islands. Eiders using the south side (the greater number) likely nest on Somerset and Prince of Wales Islands and the Boothia Peninsula; some may also go to the Adelaide Peninsula and King William Island. Again, timing and distribution are greatly affected by ice cover (Alliston *et al.* 1976, McLaren and McLaren 1982).

In addition to major routes along the coastlines, polynyas, and other open water, overland migration may occur across southern Baffin Island. King Eiders occur in mid-April and early May at the upper end of Frobisher Bay and Cumberland Sound (Soper 1928, MacLaren Marex 1979). Soper (1928) found several hundred at Nettiling Fiord and noted a large flock flying northwest over Nettiling Lake 2–3 weeks later (few nested there); he also cites Hantzsch's similar observations while travelling to Nettiling Lake. Ellis and Evans (1960) reported large flocks of eiders ("probably" Kings) at the floe edge near Igloolik Island on 11 April, a very early date if they had arrived via either of the major routes. The three polynyas in northwestern Foxe Basin (Smith and Rigby 1981) may have been the eiders' immediate destination, as staging areas.

7.4. Population status □

The existing data do not allow us to estimate the eastern arctic breeding population. Although nest densities have been reported from several areas, the amount of suitable habitat on large land masses is not known.

8. Discussion and conclusions □

Responsible management of wildlife populations can only be accomplished when decisions stem from solid data on basic population parameters. Our review of the literature reveals that such a data base does not currently exist for Northern, Hudson Bay, or King Eiders breeding in the eastern Canadian Arctic. Yet the new information in this publication (Chapdelaine, Bourget, *et al.*; Gaston and Cooch; Lock; Nakashima) and our compilation of historical data on numbers and distribution bring us a step closer to having one.

The need for better population data is acute. Eiders are extremely gregarious and local events can have an impact on large proportions of populations. Hydrocarbon development in Hudson Bay poses a threat to Hudson Bay Eiders; oil spills in winter represent a particularly large risk for a population so dependent on relatively few, restricted open water areas. The imminent hydrocarbon developments on the Newfoundland Grand Banks, although about 300 km east of the main wintering areas, may pose similar threats to Northern and King Eiders wintering there. Of greater immediate concern, however, is the effect of harvest rates on the populations. Hunting pressure on wintering and breeding areas warrants concern. Off the coasts of Newfoundland and Labrador, Northern Eiders are shot in large numbers (Wendt and Silieff, this publication; Reed and Erskine, this publication). In the Arctic, both Hudson Bay and Northern Eiders are harvested year-round and their eggs collected in spring. Hunting and egging were identified as the prime causes of a drastic reduction in nesting populations near Cape Dorset (Cooch 1977, this publication) and could be having a similar effect in other local areas. Further appraisal of the effects of harvesting on Common Eider populations of eastern North America can be found in Reed and Erskine (this publication).

It is useful to point out the weaknesses in the existing data base and to consider briefly what priorities might be applied to data acquisition initiatives.

The major problem for both races of Common Eider and for King Eiders is our inadequate knowledge of their distribution. Only northern Labrador (Lock, this publication) and Ungava Bay (Chapdelaine, Bourget, *et al.*, this publication) have been systematically surveyed for nesting colonies. The locations of the majority of *sedentaria* colonies are unknown, and although we know the locations of more *borealis* colonies, the majority have not been quantified. The nesting distribution of King Eiders precludes even the relatively straightforward, if expensive, solution available for Common Eiders (i.e., finding and quantifying colonies). A similar inadequacy of data pertains to winter distribution. The major wintering location of *sedentaria* is presumed to be the vicinity of the Belcher Islands but no systematic survey has been attempted. Only Manning (1976) provides any numbers and his total (2300 birds) represents only 5% of our estimated population. Again, although the winter distribution of *borealis* is better known, the isolation of Canadian breeding birds from Greenland breeding birds, the overlap with *dresseri* and the existence of intergrades are problems which would have to be overcome if a winter population inventory is to be successful. The topic of intergradation of races and overlap during the breeding season deserves more attention as well. Finally, there is a general lack of information on reproductive rates and mortality rates, which makes it impossible to make good estimates of population dynamics.

Despite these difficulties, we used the available data to try to construct population size estimates for *sedentaria* and *borealis*. Obviously, they are preliminary and should be used cautiously. Being based largely on non-replicated surveys, neither the calculation of confidence limits nor the determination of gross upper and lower limits was possible.

The most pressing need for all three populations is systematic inventory of numbers and distribution. A combination of ground surveys to locate and quantify nesting colonies and aerial surveys to extrapolate a population estimate should be feasible for *sedentaria*. A winter survey of polynyas and leads in Hudson and James Bays may provide the best estimate of total population size for *sedentaria*. Breeding ground surveys for *borealis* should probably be concentrated on the heart of their range (both sides of Hudson Strait) and near the polynyas in more northern areas. Replication of recent aerial surveys (Chapdelaine, Bourget, *et al.*, this publication; Gaston and Cooch, this publication) should help refine our estimates. Banding studies are also urgently needed for both distributional and mortality rate studies, especially in breeding areas thought to contribute most to heavily harvested wintering areas. Finally, the relationship between distribution and underlying biotic and abiotic factors (especially the primary productivity – invertebrate – eider food web) must be better understood if the challenge of managing populations by protection of vital resources is to be met.

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Eiders of the western Canadian Arctic

Les eiders de la partie occidentale de l'Arctique canadien

T.W. Barry

1. Abstract

The only eiders that nest regularly in the western Canadian Arctic are the King Eider (*Somateria spectabilis*) and the Pacific race of the Common Eider (*S. mollissima* v. *nigra*). The King Eider, which nests near inland lakes and ponds, is abundant and widely distributed. The Pacific Eider, being restricted to those marine habitats that become ice-free early in spring, is less numerous and distributed irregularly. Because of lengthy and extended spring, fall, and moult migrations between the Canadian Arctic and the Chukchi Sea, there is a continual movement of eiders across the Beaufort Sea from April to early November.

2. Résumé

L'Eider remarquable (*Somateria spectabilis*) et l'Eider à duvet (*S. mollissima* v. *nigra*) sont les seules espèces d'eider qui nichent régulièrement dans la partie occidentale de l'Arctique canadien. L'Eider remarquable, qui niche près des lacs et des étangs d'eau douce à l'intérieur des côtes, est abondant et montre une distribution étendue. L'Eider à duvet se confine aux sites maritimes qui se libèrent des glaces tôt au printemps; sa distribution est irrégulière et ses effectifs moins élevés. Les deux espèces effectuent de longues migrations entre la mer de Chukchi et l'Arctique canadien au printemps, durant la période de la mue et à l'automne. Il y a donc un va-et-vient continu d'eiders au-dessus de la mer de Beaufort entre les mois d'avril et novembre.

3. ᓄᐃᑎᑕᐅᔪᑦ

ᐅᑯᐊ ᑭᓯᐊᓂ ᒫᓂᓕᐅᕇᓇᓱᑦ ᑲᓇᑕᐅᑉ ᑕᕐᕿᖓᓂ ᖃᖓᓕᐅᕙᑦ (ᓴᒪᑎᐅᕆᔭ ᓯᐱᒃᑕᐱᓕᔅ) ᐊᒻᒪᓗ ᒪᓂ Pacific-ᒥ ᐃᒪᕐᐱᒥ ᒥᑎᑐᐃᓐᓇᐃᑦ (ᓴᒪᑎᐅᕆᐊ. ᒥᓕᓯᒪ v.ᓂᒃᓇᐊ). ᐅᑯᐊ ᖃᖓᓕᑦ. ᒫᓂᓕᐅᓱᑦ ᓴᓂᕇᓂ ᓄᓇᐅᑉ ᑕᓯᕇᓂ ᐊᒻᒪᓗ ᑕᓯᐅᕿᕐᓂ. ᐊᒥᓱᕿᑕᐅᕙᑦ ᐊᒻᒪᓗ ᓇᓂᑐᐃᓐᓇᓯᑎᒃ. ᒪᑯᐊ Pacific-ᒥ ᐃᒪᕐᐱᒥ ᒦᑎᑦ. ᐊᑐᑎᒃᑯᖃᕿᑎᒃ ᒪᑯᓄᖓ ᐃᒪᕐᒥᐅᑕᐃᑦ ᓇᔪᒐᕇᓄᑦ ᑐᕚᒃᑭᓐᓇᐃᓱᓄᑦ ᐅᓇᖓᓴᐅᓕᕐᒪᑦ. ᐊᒥᓱᕆᓂᕐᓴᐅᕙᑦ ᐊᒻᒪᓗ ᓇᓄᑐᐃᓐᓇᕇᓂᓴᐅᑦᓯᑎᒃ. ᐅᑭᐊᒃᑲᐱᓯᕝᔪᓂᖓᓄᓪᓗ ᐊᒻᒪᓗ ᐊᐅᓚᓂᕆᑎᒍᑦ ᐊᑯᓐᓂᖓᓂ ᑲᓇᑕᐅᑉ ᑕᕐᕿᖓᓂ ᐊᒻᒪᓗ Chukchi ᑕᓇᐅᖓᓂ. ᑲᔪᓯᓂᒃᑯᓚᐅᓗᐊᖅ ᐊᐅᓚᓂᖓᓂᒃ ᒦᑎᑦ ᒪᓂᓕᒪᖅ Beaufort Sea-ᒥ ᐊᐅᓇᓕᒥᑦ ᓄᕕᐱᓇᒧᑦ ᑎᑭᑎᑦᓱᒍ.

4. Introduction

Of the four species of eiders found in northwestern North America only the Common or Pacific Eider (*Somateria mollissima* v. *nigra*) and the King Eider (*Somateria spectabilis*) regularly occur in the western Canadian Arctic. The Steller's Eider (*Polysticta stelleri*) and the Spectacled Eider (*Somateria fischeri*) occur accidentally or casually in Canada, although they nest in Alaska east to Barter Island (Gabrielson and Lincoln 1959) and are sometimes seen in Demarcation Bay, Yukon (H. Gordon pers. commun., 1968).

This report discusses only Pacific and King Eiders. The initial section on breeding treats each species separately but subsequently they are discussed together, mainly because so many of the reported observations relate to mixed flocks.

5. The breeding season

5.1. Pacific Eider

The Pacific race of the Common Eider is a regular breeder along the coasts of Alaska and northeastern Asia (Palmer 1976). Its Canadian range includes the mainland coasts of the Beaufort Sea, Amundsen Gulf, Dolphin and Union Strait, Coronation and Queen Maud Gulfs, as well as Banks and Victoria Islands. Nesting generally occurs in colonies of several to several hundred nests but solitary or scattered nesting is frequent within the Canadian range. Major concentrations occur on western Victoria Island (Prince Albert Sound, Prince of Wales Strait), on Banks Island, at the eastern extremity of Dolphin and Union Strait, as well as near Cape Parry (Fig. 1). Distribution in and to the east of Coronation Gulf is not well known but two colonies of about 25 pairs were reported for Finlayson and Jenny Lind Islands near Cambridge Bay (Parmelee *et al.* 1967) and nesting may occur as far east as King William Island and Simpson Strait (Gavin 1947, Fraser 1957). Although a female was observed in summer on Melville Island (Maltby 1978), there is no evidence of breeding north of M'Clure Strait and Viscount Melville Sound.

Records from the 19th century (McFarlane 1891, Bodfish 1937) suggest the presence of colonies in the Liverpool Bay – Cape Bathurst area, presumably the same reported by Anderson (1937): presently only one small group is known to remain, occupying a barrier beach in Harrowby Bay, southwest of Cape Bathurst.

Nest sites are usually on islands or barrier beaches where they are secure from arctic foxes (*Alopex lagopus*). In most cases the islands are sand, gravel, or shingle, with some covering of kelp, seawrack, and occasionally driftwood. Preferred sites are vegetated with grass (*Elymus* sp.), sedges (*Carex* spp.), mosses, saxifrage, and so on.

The observed distribution in the western Canadian Arctic reflects the species' requirements for small islands near marine feeding areas that remain ice-free from the time the birds lay their eggs until the young fledge. The eiders lay their eggs from about 14 June in southern portions of the study area to 10 July at the northern limit (Allen 1982, McLaren and Alliston 1981, Barry and Barry 1982). The eggs hatch between about 7 July and 15 August, with a peak in late July. Assuming that the young can fly at 60–65 days (Palmer 1976), fledging would occur from late August through early October. On our surveys of eiders in Amundsen Gulf and Prince of Wales Strait on 24 September 1981 we estimated 10–15% of the eiders seen could not yet fly (Barry and Barry 1982). At that time, ice was forming on the protected coastal bays.

Thus the presence of open water in spring in the Cape Bathurst polynya and its adjoining leads as well as in the Lambert Channel polynya in Dolphin and Union Strait (Smith and Rigby 1981) helps explain the concentrations on Banks Island, Parry Peninsula, and Dolphin and Union Strait. The later availability of open water in Coronation and Queen Maud Gulfs, where the ice melts *in situ* because of weak currents (Pilot of Arctic Canada 1970), probably renders this area less suitable for nesting eiders; however, some river mouths open about 5–14 June (Gavin 1947) and may furnish additional water for eiders migrating to Coronation and Queen Maud Gulfs (Parmelee *et al.* 1967, Gavin 1947, Fraser 1957). Open water is available in early spring off the west coast of Prince Patrick Island (Smith and Rigby 1981) but Pacific Eiders do not nest there, perhaps because of a paucity of marine food sources and small islands.

In the course of surveys of Prince of Wales Strait and along the southeast mainland coast of Amundsen Gulf, I noted that family groups scattered along the shore generally contained 15–30 young, attended by one or more females. Near the large colonies off southwestern Victoria Island, the crèches were much larger, with up to 500 young, and there were proportionately fewer females with them. Perhaps the solitary and beach-nesting female eiders are in better condition than those in the colonies and more able to stay with the young. Or perhaps all the broods eventually consolidate into larger crèches and the females gradually leave.

5.2. King Eider

This species is an abundant breeding duck throughout most of the western Canadian Arctic (Fig. 1). It is also abundant in the eastern Arctic (Abraham and Finney, this publication), in Greenland (Salomonsen 1950–51), and in the Palearctic (Cramp 1977).

In contrast to the Common Eider, this species does not generally nest in colonies and makes extensive use of freshwater habitats during nesting. The King Eider can therefore take advantage of the first meltwater pools, which appear before marine habitats become ice-free and available to Pacific Eiders. The pools allow it to nest earlier than Pacific Eiders and to the northern limits of land in the arctic islands (Godfrey 1966, Palmer 1976). However, King Eiders often move to deeper lakes and coastal areas while they are rearing their broods.

The nesting habitat of King Eiders varies from tundra polygons and grass and sedge meadows with ponds and lakes to raised beaches and gravelly or rocky ridges. The presence of nearby ponds or lakes is important (Maltby 1978). From aerial surveys of western Victoria Island, McLaren and Alliston (1981) found the preferred habitat to be tundra that was more than 75% vegetated and contained ponds. Their ground surveys showed that 81% of King Eider nests were on closed graminoid meadow, whereas 11% were on closed graminoid – dwarf shrub tundra, and 8% on open graminoid – dwarf shrub tundra.

All of the western Canadian arctic islands that have such habitat are occupied by breeding King Eiders (Fig. 1), with Victoria and Banks Islands accounting for approximately 90% of the western arctic population (Barry 1960). On the mainland they nest on Alaska's north slope, but breed only occasionally westward through northern Yukon, the MacKenzie Delta, Amundsen Gulf, and western Coronation Gulf; their relative scarcity is due perhaps to the taller and denser vegetation of this subarctic area. Near Queen Maud Gulf the vegetation is more typically arctic and King Eiders nest commonly (Hanson *et al.* 1956).

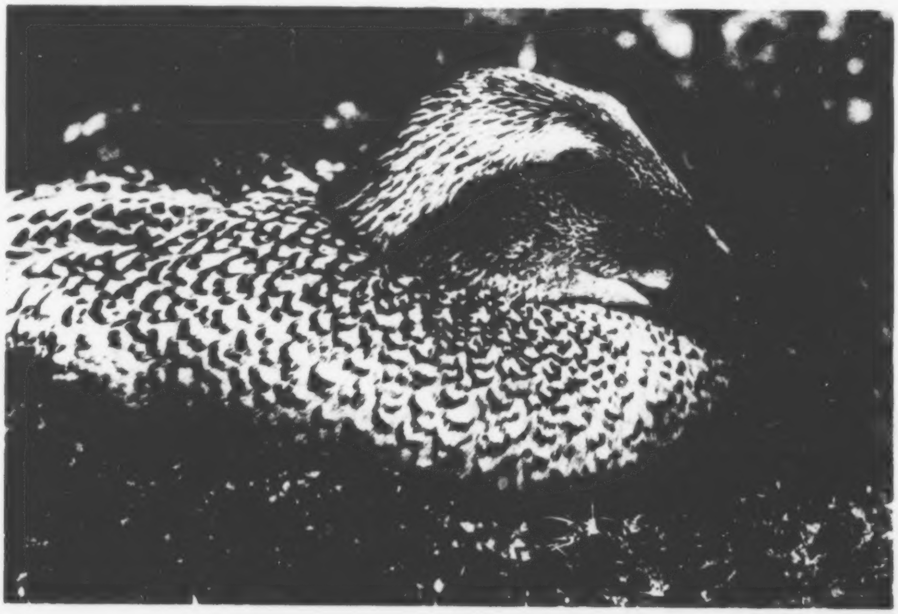
Lamothe (1973) discusses the breeding biology of this species in more detail.

6. Migrations and moult

6.1. Moult and fall migration

Males of both species leave the nesting areas once their mates have begun incubation and migrate westwards to distant moulting areas. Some females probably accompany the males, or later join them, but others remain to moult near the nesting locations, often in the company of their broods or crèches. In fall, when this latter group of females and young birds are capable of flight they migrate westwards along the same general path as the moult migrants. Thus there is a continual westward exodus of eiders from the western Canadian Arctic towards the Alaskan portion of the Beaufort Sea and the Chukchi Sea from early July until November. Some birds continue through to the Bering Sea (Bartonek and Gibson 1972, King and Dau 1981, Kistchinski 1973).

King Eiders generally gather in small flocks and start west in late June and early July. On eastern Victoria Island and Jenny Lind Island, Parmelee *et al.* (1967) saw male King Eiders migrating on 28 June but none after mid-July. On 8 July 1981 Barry and Barry (1982) saw a flock of about 100 male King Eiders flying southwest near the southeastern edge of Prince of Wales Strait. Manning *et al.* (1956) report an exodus from Banks Island



Female King Eider on nest, Bathurst Island
Eider remarquable femelle sur son nid, île Bathurst
(photo: R.S. Palmer)

by the beginning of July in 1952, and in mid-July 1953 (a late season). Near Cape Bathurst, Anderson (1937) reported that the moult migration began in late June 1912, continuing through July; by 18 July male Pacific and King Eiders were passing through in equal numbers.

At the eider pass at Point Barrow, Alaska, the moult migration of male King Eiders was underway 13 July 1970 when Johnson (1971) began his counts; he recorded the largest migration of both species in the last week of July. He saw female eiders after 7 August, and by 17 August only a small percentage of males. Thompson and Person (1963) found a similar situation at Point Barrow. Allen (pers. commun., 1982) observed that female eiders arrived at McKinley Bay (northwest coast of the Tuktoyaktuk Peninsula) on 26 July, and all had departed westwards by 13 August.

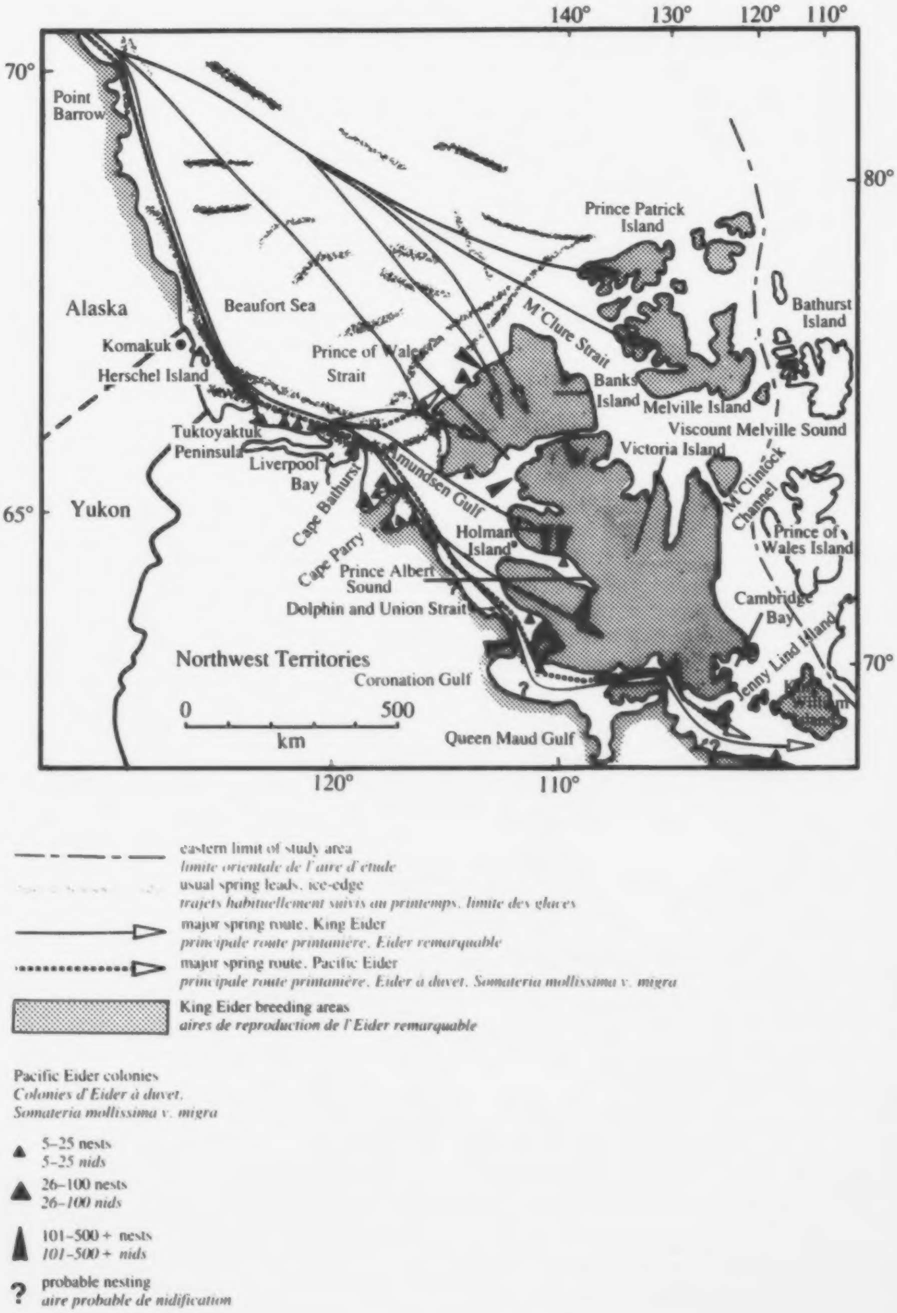
The destination of those moult migrants is not fully known. Palmer (1976) indicates that some Pacific Eiders moult in the Bering Sea. However, there is speculation that King Eiders and some Pacific Eiders moult in the Chukchi Sea, far off Point Lay, Alaska, where there is usually open shallow water that permits feeding from June through October (Springer and Roseneau 1979). We have not been able to confirm reports of large flocks of moulting King Eiders off Point Lay.

Not all western Canadian arctic eiders join the moult migration. Flocks of predominantly female Pacific Eiders remain in coastal bays in August, as reported by Ward (1979), at Cape Parry, by Allen (1982) for the northwest coast of the Tuktoyaktuk Peninsula, and by Barry *et al.* (1981) at Harrowby Bay near Cape Bathurst. Some males in eclipse plumage are also present in August and September in small groups, or with females. We saw flightless Pacific Eiders at Cape Parry and Prince of Wales Strait on 24 September 1981 (Barry and Barry 1982). During our surveys of moulting sea ducks in July–September 1980 and 1981, we found no male King Eiders, but inland large crèches were present with a few adult females in attendance.

Thus some adult eiders moult in the western Arctic, but the females' need to recoup from incubation prompts most to leave for the food-rich Bering and Chukchi Seas. The wing moult most likely occurs in late July for male King Eiders, early August for male Pacific Eiders, mid-August through mid-September for female King Eiders, and throughout late August and September for female Pacific Eiders.

The young eiders, and the few adult females that remain to moult, begin their fall migration shortly after attaining flight.

Figure 1
Spring migration routes and nesting areas of Pacific Eiders and King Eiders in the western Canadian Arctic
Routes de migration au printemps et aires de nidification de l'Eider remarquable et de l'Eider à duvet (Somateria mollissima v. nigra) dans la partie occidentale de l'Arctique canadien



140°
130°
120°
110°
70°
80°
65°
70°
120°
110°
Point Barrow
Alaska
Beaufort Sea
Komakuk
Herschel Island
Prince of Wales Strait
Prince Patrick Island
M'Clure Strait
Bathurst Island
Banks Island
Melville Island
Viscount Melville Sound
Victoria Island
M'Clintock Channel
Prince of Wales Island
Tuktoyaktuk Peninsula
Liverpool Bay
Amundsen Gulf
Cape Bathurst
Yukon
Cape Parry
Holman Island
Prince Albert Sound
Dolphin and Union Strait
Cambridge Bay
Jenny Lind Island
King William
Northwest Territories
Coronation Gulf
0
500
km
Queen Maud Gulf
eastern limit of study area
limite orientale de l'aire d'étude
usual spring leads, ice-edge
trajets habituellement suivis au printemps, limite des glaces
major spring route, King Eider
principale route printanière, Eider remarquable
major spring route, Pacific Eider
principale route printanière, Eider à duvet, Somateria mollissima v. nigra
King Eider breeding areas
aires de reproduction de l'Eider remarquable
Pacific Eider colonies
Colonies d'Eider à duvet,
Somateria mollissima v. nigra
5–25 nests
5–25 nids
26–100 nests
26–100 nids
101–500 + nests
101–500 + nids
probable nesting
aire probable de nidification

Timson (1976), who studied the migrations of female eiders past Point Barrow from 27 August to 16 September 1975, reported that 97% of those he could identify were King Eiders and 3% were Pacific Eiders. Adult female and juvenile King Eiders are common migrants at Nunivak Island, eastern Bering Sea, in mid-September (King and Dau 1981). In November a similar movement of predominantly adult males occurs. One band recovery from this period suggests that at least some of these birds are from the Soviet Arctic.

Through October and November the eiders migrate to wintering grounds near the Aleutian Islands, as the freeze-up advances south into the Bering Sea. Flock's (1973) radar studies showed that the fall migration of waterfowl was still intense at Point Barrow during October and it continued through the first week of November; presumably many of the migrants were young eiders. Barry *et al.* (1981) observed eiders migrating past Johnson Point on Banks Island on 20 October 1980: with daylight lasting only a few hours, the temperature at −30°C, and the straits nearly covered with shifting brash ice in a strong current, flocks of 75–100 eiders passed continually in a southward direction.

6.2. Spring migration □

Both the Pacific Eider and the King Eider winter in the Bering Sea near the Aleutian Islands and north wherever there is open water, perhaps into the Chukchi Sea (Gabrielson and Lincoln 1959, Kitchinski 1973, King and Dau 1981). Migrants leave the Bering Sea in late March or in April, depending on occurrence of open leads. Their route follows the ice-edge or shore-leads rounding Point Barrow, although some may cut overland (Myers 1958, Irving 1960, Flock 1973). The peak of spring migration at Point Barrow is about 25 May for King Eiders and 7 June for Pacific Eiders (Anderson 1937, Johnson 1971, Woodby and Divoky 1982).

The migration of Pacific and King Eiders to nest sites in the western Canadian Arctic is predominantly a west–east migration, rather than south–north. From Point Barrow eastwards into Canadian waters King Eiders spread out over a broad front (Richardson and Johnson 1981), probably on a direct route towards the lead off the west side of Banks Island, which is their spring staging area, before moving on to traditional nesting areas (Fig. 1). However, some King Eiders follow the many Pacific Eiders along the shore-leads that form a pathway eastwards to nesting grounds on southern Victoria Island and the mainland to the south.

King Eiders have been reported at the floe-edge off the west coast of Banks Island as early as 10 April (Manning *et al.* 1956). The first arrivals are predominantly male eiders (B. Jacobson, pers. commun.; D. Nasagalauak, pers. commun.). Inuit, hunting polar bears in April, have found eiders frozen in where leads along the shore-fast ice off the northern tip of the Tuktoyaktuk Peninsula and the west side of Banks Island have refrozen or been closed in by pack-ice driven by northwest winds. The southern two-thirds of the west coast of Banks Island is the largest known spring staging area for King Eiders: as many as 95 000 have been observed at one time.

Depending on ice conditions, large numbers of Pacific Eiders stage off the northern tip of the Tuktoyaktuk Peninsula and near Capes Bathurst and Parry early in June, or proceed further eastwards to the next open lead, either at Cape Baring at the entrance to Prince Albert Sound or in Dolphin and Union Strait, where 18 408 were counted in a 2-h period on 10 June 1980 (Allen 1982). At Finlayson Islands near Cambridge Bay and at Jenny Lind Island further east in Queen Maud Gulf, Parmelee *et al.* (1967) first saw King Eiders on 3 June and Pacific Eiders on 7 June.

Pacific and King Eiders seen during ice-edge surveys of 5 June 1980 and 9 June 1981 had an equal sex ratio (Barry and Barry 1982, Barry *et al.* 1981). Allen (1982) also noted equal sex ratios and regular courtship displays among Pacific Eiders in Dolphin and Union Strait during flock counts between 6 and 19 June 1980. Thus the observations of Pacific Eiders in pairs at their spring staging areas in southwest Prince Albert Sound and in Dolphin and Union Strait, and of paired King Eiders on west Banks Island, indicate that pair formation as well as feeding and resting, may occur at staging areas. Woodby and Divoky (1982) noted that eiders, King Eiders in particular, were not paired when they passed Point Barrow in late May; they surmised that pairing would occur when the females caught up with the males on the spring staging waters.

Palmer (1976) reports that most immature male eiders probably do not leave the Chukchi Sea. However, immature female King Eiders have been collected in nesting areas (Hanson *et al.* 1956); possibly these birds play a role, along with failed nesting females, in attending the crèches.

King Eiders usually quit their main spring staging areas earlier than Pacific Eiders but may be retarded when snow melt and pond thaw is delayed on their inland nesting areas. Such was the case on 11 June 1982 when snow persisted on Banks and Victoria Islands; well over 95 000 King Eiders were still in their traditional lead west of Banks Island and more than 1500 on a 2-ha meltwater pond near the mouth of Big River, Banks Island, the only fresh water available at the time.

Typically Pacific Eiders are strung out along the shore-leads of the mainland coast from Dolphin and Union Strait westward past Point Barrow in early June. Because of their later migration and nesting dates they are less affected by persistent snow-cover on land.

Using hydrographic charts and satellite photographs of shore-leads (Barry *et al.* 1981, Stirling and Cleator 1981) we found that eiders were concentrated on water 10–20 m deep. Within those aggregations eiders dove frequently, apparently in search of food. Palmer (1976) reports that Pacific Eiders dive 16 m, whereas King Eiders reach 20 m or more. Todd (1979) reports that King Eiders dive to 60 m. Fewer eiders are found in leads with water deeper than 40 m (e.g., off Herschel Island and across Amundsen Gulf). I rarely saw eiders dive.

In rectilinear leads in the pack-ice west of Banks and Prince Patrick Islands, Fraker (1979 and pers. commun.) saw eider ducks (which my subsequent investigations showed to be King Eiders) resting on the water or flying in the direction of Banks Island. These leads, 400–500 km offshore, are on a direct 1120-km route from Point Barrow to Banks Island (Fig. 1).

Flock formations are similar in brant (*Branta bernicla nigricans*), Oldsquaw ducks (*Clangula hyemalis*), and eiders, all of which regularly migrate over pack-ice or open seas. Groups close to the surface of the water usually fly in long undulating lines; higher flocks are usually in bunches. Altitude over pack ice is usually from 30 to 400 m, but over leads flight levels average 6 m (Allen 1982). Richardson and Johnson's (1981) radar studies of spring migrants at Komakuk, sponsored by the Canadian Wildlife Service (CWS), showed unidentified birds migrating northeast from the shore at heights up to 2600 m. Presumably some of these were eiders. C. Dau (pers. commun.) observed spring migrating King Eiders 10 km inland over the Yukon Delta, Alaska. The flocks were composed of 25–300 birds, predominantly males (ca. 75%), flying close together 10–30 m above the ground.

7. **Population status**

There have been no systematic surveys of eiders in the western Canadian Arctic. Various authors have speculated there are about one million birds. Because the eiders nest in remote areas and usually migrate on a broad front well offshore, systematic surveys in this area are not presently feasible. Migration watches at Point Barrow, Alaska, where most eiders entering or leaving the Beaufort Sea are believed to pass within visual or radar range of shore, probably offer the best opportunity for counting. Such counts, however, would require lengthy periods of observation. To cover the complete spring migration of both species the watches would have to extend from mid-April through July, by which time moult migrating eiders would have begun to move through in the opposite direction, followed closely by fall migrants. Other difficulties include identification of species and breeding status of birds recorded, and the likelihood that an unknown proportion of the population passes out of range.

Observations at Point Barrow (Thompson and Person 1963, Timson 1976, Woodby & Divoky 1982) suggested that 5–10% of the migrating eiders were Pacific Eiders. I consider this proportion to be more accurate than those I have observed on ice-edge surveys and watches in the southeastern Beaufort Sea, because east of Point Barrow many King Eiders disperse northwards. Applying that ratio to the total population yields an estimate of approximately 50 000 – 100 000 Pacific Eiders.

A few Pacific Eider colonies have been discovered and additional indications of breeding abundance and distribution can be surmised from spring surveys. On the basis of the available information I estimate the minimum numbers of breeding Pacific Eiders in the western Canadian Arctic as follows:

Coastal islands and beaches (Yukon to Cape Bathurst)	300
Cape Parry (Franklin and Darnley Bays)	1 000
Banks Island (west and south shore)	1 400
Victoria Island (Prince of Wales Strait – Prince Albert Sound)	5 400
Dolphin and Union Strait (nesting islands)	3 400
Dolphin and Union Strait (migrants)	70 000
Total	81 500

It would be interesting to check out the numerous possible nesting islands on Coronation and Queen Maud Gulfs for Pacific Eiders.

8. Discussion and conclusions

In the eastern Arctic, leads and polynyas extend north to about 79°N and west into Lancaster Sound, Jones Sound, and Penny Strait to about 90–95°W, permitting the eastern race of Common Eider (*Somateria mollissima borealis*) to nest earlier and further north (Prach, pers. commun.). Separating the open-water areas of the eastern and western Arctic is a band of permanently frozen seas: M'Clintock Channel, Viscount Melville Sound, and M'Clure Strait. For the Pacific Eider that area forms an eastern and northern barrier to its nesting range (Parmelee *et al.* 1967, Palmer 1976).

Because King Eiders are able to nest inland from the end of open water, areas such as Queen Maud Gulf, King William Island, Melville Island, and Bathurst Island may be occupied by eiders from the eastern population (Salomonsen 1968). Parmelee *et al.* (1967) suggest that from eastern Victoria Island, part of the King Eider population migrates east and part west. I consider the estimate of one million eiders that migrate past Point Barrow (Thompson and Person 1963) too low to account for all the eiders breeding in the western Arctic, and suggest that many King Eiders migrate to the east.

Eiders are subject to natural calamities that vary in intensity and geographical extent. Most spectacular are the periodic wrecks of eiders along the Alaskan and Canadian coasts during spring migration when wind and ice conditions close off open water in traditionally used flaw leads or polynyas. This closed-ice condition may be local, as at Tuktoyaktuk Peninsula (Barry and Barry 1982), or extend over the entire eastern Beaufort Sea and its marine approaches (Barry 1968). Because male King Eiders are the first migrants of the spring season they are most seriously affected. Palmer (1976) and Woodby and Divoky (1982) discuss this further.

King Eider crèches move from freshwater ponds to larger lakes or to the sea in August and early September, thus avoiding the freeze-up of shallower, smaller waters. However, not all escape: in the largest lake in the nesting area on Banks Island we found the remains of 125 King Eiders, mostly unfledged young and a few adult females, presumably frozen-in the previous fall (Barry 1968). At sea, where freeze-up occurs as late as October or November, crèches of both species are less likely to be caught, even in the shallower waters where they feed.

In years of arctic fox (*Alopex lagopus*) abundance, an appreciable toll of eggs and nesting female eiders may be taken. That threat undoubtedly reinforces the tendency to nest on islands, in wet meadows, and on tundra polygons when ice and snow has melted to form a protective moat around the nest site. Parasitic Jaegers (*Stercorarius parasiticus*) and Glaucous Gulls (*Larus hyperboreus*) prey on eider eggs and young, the former species displaying only a limited ability to take young eiders (Martin and Barry 1978). In the western Arctic neither the Long-tailed Jaeger (*S. longicaudus*) nor the Pomarine Jaeger (*S. pomarinus*) is an important predator on eiders. The Glaucous Gull is an opportunistic predator on both eggs and young eiders. It often breeds in association with eiders. The small colonies of Pacific Eiders along the mainland coast from Nunaluk Spit south of Herschel Island to Cape Bathurst are all associated with Glaucous Gull colonies. Their effect on nesting success of eiders appears to vary considerably from colony to colony (see Strang 1976, Schamel 1977) but no data are available to evaluate the overall impact.

The importance of eiders to the Inuit of the western Canadian Arctic and Alaska is no longer manifest: the use of bolas and whalebone snares (Simpson 1843, Murdoch 1892) to capture eiders is barely remembered by elderly residents, and eider-skin parkas are now museum pieces or are worn only in ceremonial drum dances. The eider passes at Point Barrow (Murdoch 1892, Thompson and Person 1963, Johnson 1971) and at Holman Island (Smith 1973) are the most important places for hunting by natives. We estimate that about 10 000 – 20 000 eiders, mostly King Eiders, are shot at these two passes each year. Because the moult and fall migrations generally bypass coastal areas, opportunity for sport hunting of eiders in the fall does not exist in the western Canadian Arctic. Approximately 250 eggs are taken, mainly near Cape Parry and Cambridge Bay. The take of eiders and their eggs by natives is diminishing and does not threaten eider populations (Barry 1968). Eiderdown collection is not practised in the western Arctic, except for plucking of feathers from shot birds. Eiders have been caught in fish nets in the Bering Sea and King Eiders are sometimes victims of strikes with lighted antennae, ship riggings, and other illuminated structures near coastlines; but the numbers so killed are not known.

In the Beaufort Sea, where massive exploration and extraction of oil is underway, there is considerable concern for eiders lest a spill occur near the flow zone between land-fast and pack ice. Spring migrants are attracted to open water and to anything that resembles an opening in the sea ice. Thus an oil spill in an open lead, on the ice, or percolating up to the ice surface could be disastrous to many Pacific and King Eiders in the western Arctic. Essential areas of wintering eider habitat in the Bering Sea are also facing an era of rapid petroleum exploration and development. The large potential threat posed by an oil spill emphasizes the need for careful monitoring and additional research on the eider ducks of western North America. Further work is required to more fully document the location and ecological importance of spring staging areas for both species. The formation and movements of crèches are inadequately understood for both species, as is the relationship between food resources and the distribution of ducklings, attending females, and other categories of the population. A more comprehensive study of moulting locations, moult migrations, and late fall migration should be undertaken.

9. Acknowledgements

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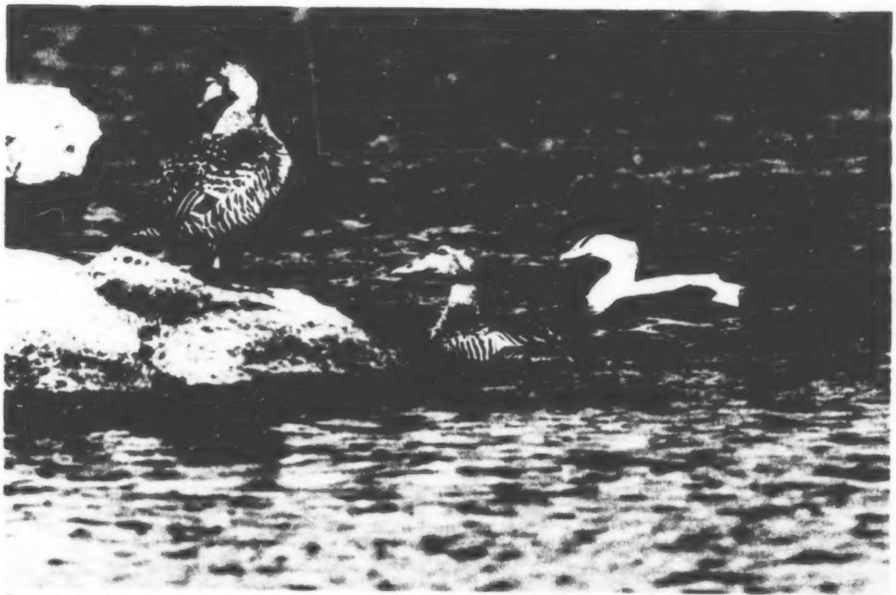
Part II Races of Common Eiders

Section II Sous-espèces d'Eider à duvet



Somateria mollissima borealis
(photo: R.S. Palmer)

Somateria mollissima dresseri
(photo: A. Reed)

Identification of eastern races of the Common Eider

Identification des sous-espèces de l'Eider à duvet de l'Est

H.L. Mendall

1. Abstract

Bill measurements were taken of three subspecies of eastern American Common Eiders: *Somateria mollissima borealis*, *S. m. dresseri*, and *S.m. sedentaria*, and also *borealis-dresseri* intergrades, as an aid in recognizing these races. Live birds and fresh specimens were primarily from Labrador, Newfoundland, Quebec, and Maine, and museum skins were from various parts of their ranges. Of three bill measurements used, the frontal extension, although helpful, did not permit racial separation as well as total bill length or distance from the nostril to the posterior extension of the frontal lobe. Either or both of the two latter measurements permitted separation among adult females of most individuals of the various subspecies and intergrades. With adult males, the total bill length alone permitted racial separation, although the other measurements were of value in borderline cases. The system of bill measurements described, when used in conjunction with shape of the frontal lobe, should materially increase accuracy of racial determination.

2. Résumé

Les dimensions des becs des trois sous-espèces de l'Eider à duvet qui habitent l'est de l'Amérique, *Somateria mollissima borealis*, *S.m. dresseri* et *S.m. sedentaria*, ainsi que celles des intermédiaires *borealis–dresseri*, furent mesurées afin de faciliter leur identification. Le matériel incluait des spécimens vivants ou fraîchement tués provenant du Labrador, de Terre-Neuve, du Québec et du Maine, ainsi que des spécimens conservés dans différents musées provenant de diverses parties de l'aire de distribution de l'espèce. Des trois paramètres mesurés, l'extension frontale, quoique utile, était moins discriminante que la longueur totale du bec et/ou la distance entre la narine et la limite postérieure du lobe frontal. Ces deux derniers paramètres, seuls ou en combinaison, permettaient d'identifier la sous-espèce chez la majorité des femelles adultes. Un seul de ces paramètres, la longueur du bec, suffisait pour identifier les mâles adultes, mais les autres paramètres s'avéraient utiles dans les cas marginaux. L'utilisation des mesures du bec, en combinaison avec une évaluation de la forme du lobe frontal, devrait permettre une plus grande précision dans l'identification des différentes sous-espèces.

3. Introduction

Five subspecies of the Common Eider (*Somateria mollissima*) occur in North America (Palmer 1976). Of these, *S.m. borealis* has the most extensive range, and is in contact with three other subspecies at some season of the year: with *S. m. islandica* in Greenland; with *S. m. dresseri* in Labrador during summer, and throughout Atlantic Canada and Maine during winter; and with *S. m. sedentaria* in Hudson Bay in summer. Only the western race, *S. m. v-nigra*, appears isolated from any of the other four.

In a recent publication (Mendall 1980), I described briefly the overlaps in ranges of *borealis* with those of other subspecies, and I discussed racial intergradation. I concluded that *borealis-dresseri* intergradation occurs regularly over an extensive portion of the central and south-central Labrador coast. I also presented indirect evidence that *borealis-sedentaria* intergradation occurs in the vicinity of Chesterfield Inlet in northwestern Hudson Bay. It seems likely, as well, that *borealis-islandica* intergrades are found in western Greenland.

With the present increased interest in eider distribution and management, it is desirable to identify individuals of the various races as accurately as possible. Differences in body size are relatively slight and plumages vary greatly by age, season, and region. The most usual identifying character has been the shape of the frontal lobes of the bill. However, identification according to this character has always been subjective and requires experience in examining many specimens. Identification becomes especially troublesome when dealing with possible intergrades or atypical specimens.

To aid in racial identification, I presented (Mendall 1980) a series of bill measurements of adult female eiders of *borealis*, *sedentaria*, *dresseri*, and *dresseri-borealis* intergrades which could be used in conjunction with the shape of the frontal process. I used only data from summer-collected adults, to permit geographic comparisons of different breeding populations. The bill measurements, in conjunction with the more subjective criteria, resulted in probable identification accuracy at the 95% level. The present paper extends this system of bill meaurements to other sex and age groups of eastern races of the Common Eider.

4. Methods

To determine subspecies and intergrades, I used the following sources: (1) live birds trapped for banding in Maine and Labrador (nesting females); (2) fresh specimens (all sex and age groups) from Maine, Newfoundland, and Quebec, examined by personnel of the Canadian Wildlife Service (CWS) and the Maine Cooperative Wildlife Research Unit; (3) preserved specimens (all sex and age groups) from the following museums: University of Maine, Bowdoin College, Museum of Comparative Zoology, Carnegie Museum, United States National Museum, Royal Ontario Museum, and National Museum of Canada.

Summer specimens of adult females from specific breeding areas were the same as those used by Mendall (1980); these have been supplemented in the present paper by adult females killed in fall, winter, and spring in eastern Canada and northeastern United States. Eiders of all other sex and age classes were from the museum collections listed except for a limited series of fresh specimens from Maine and some birds illegally killed on the north shore of the Gulf of St. Lawrence and confiscated by Quebec authorities.

In tabulations involving immature eiders (birds less than 1 year old), only specimens taken after 1 November were used.

In my previous study of adult female eiders (Mendall 1980), four bill measurements were used (Fig. 1), but it was shown that the length of the culmen midline was too variable to be satisfactory in racial determination. Thus, in the present paper only the other three measurements are used. These are defined as follows:

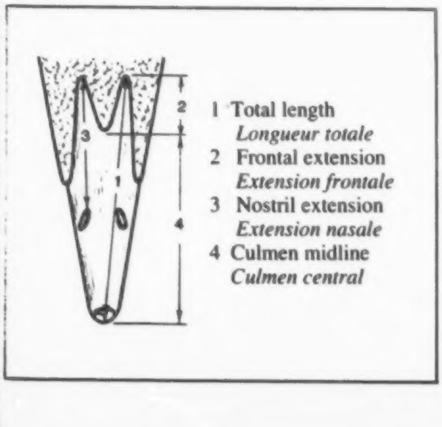
1. total length: from tip of bill to posterior end of frontal lobe;
2. frontal extension: from anterior end of feathering on top of middle of bill to posterior end of frontal lobe;
3. nostril extension: from posterior end of nasal opening to posterior end of frontal lobe.

I recorded bill measurements to the nearest 0.5 mm, and, to standardize the data, took them on the right side of the bird. Specimens with shrivelled or damaged bills were not included in the sample. Because mean bill shrinkage of museum specimens was slight (Mendall 1980) and no greater than individual human error in taking measurements, I combined museum and fresh specimens in the tabulations.

Preliminary subspecific identification was by shape of the bill processes. Frontal lobes of typical *borealis* are narrower, shorter, and much more acutely pointed than in *dresseri*; in the latter these are usually longer, broader, and more rounded. The frontal lobes of *sedentaria* resemble *dresseri* but are smaller and usually narrower, especially in females (see Figs. 2 and 3). Subspecific descriptions of eider bills have been given by several authors, particularly Snyder (1941), Todd (1963), Godfrey (1966), and Palmer (1976).

The frontal lobes of intergrades were described for adult females (Mendall 1980) as "either narrow (more so than in *dresseri* or *sedentaria*) and semi-rounded (or nearly square), or broad but conspicuously short" (see also Fig. 3). This description also appears to hold for male intergrades, although the sample is much smaller than that available for females.

Figure 1
Points of measurement of eider bills (from Mendall 1980)
Points de mesures des becs des eiders (d'après Mendall, 1980)



5. Results

Means, standard deviations, and ranges for the three measurements for adults of all four races, and for subadult and immature *dresseri* males, are shown in Table 1. The sample sizes for subadult and immature age classes of other races and sexes were too small to warrant separate tabulations. Subadult and immature males of *borealis* ($N=8$), intergrades ($N=3$), and *sedentaria* ($N=6$) showed only minor differences in means from those of adults, which were not significant ($P>0.05$). Although these are not included in Table 1, they probably could have been combined with adults. A contrasting situation was seen, however, with *dresseri*. Although there were insignificant differences ($P>0.05$) in measurements between immatures and subadults, the differences of these two age classes combined were significant ($P<0.05$) when compared with adults. Because a reasonably good sample of this group of *dresseri* was available, they are included in Table 1 and the subsequent analysis of the data.

Among females there were no obvious differences in bill measurements of the various age classes. It appears that data from immatures, taken in late fall and winter, and subadult (yearling) females could have been combined with that of adults. However, as with males, numbers were low for most of the groups.

I cannot satisfactorily explain the fact that size differences were noted only for *dresseri* males. It might be expected that measurements in all age classes below adults would be somewhat lower. Schiøler (1926) recorded such differences among Greenland *borealis* and *islandica*, although these were slight and were largely confined to "juvenals" (= immatures, in this paper). However, the degree of change was much less than that noted in the present study for *dresseri*.

Part of the differences that were detected is probably related to sample sizes, because *dresseri* made up the only category in which numbers of subadult and immature males were sufficient to justify tabulation. It is also possible that geographic variations occurred and that the sample was biased in this respect. With adult females, I found (Mendall 1980) that morphological clines existed, with regional differences in bill measurements. These differences were not significant ($P>0.05$) among *borealis* but they were significant ($P<0.05$) among *dresseri*; Labrador *dresseri* had the smallest measurements while those from Maine (southern limit of breeding) were largest. Unfortunately, the samples of males of the various races and intergrades were insufficient for satisfactory geographic separation.

It should be emphasized that the females in Table 1 are from all seasons of the year and from all geographic regions, whereas in my earlier paper (Mendall 1980) only summer eiders from known breeding areas were considered. Detection of geographic variations, when present, was easily noted through analysis of variance and multiple range tests by the Student-Newman-Keuls (S-N-K) procedure (Zar 1974); see the tabulations and discussion in Mendall (1980) for details. That study demonstrated the value of bill measurements of total length, nostril extension, and frontal extension (especially the two former) as aids in racial identification; and also showed the unreliability of the culmen midline measurement.

A comparison of the data in Table 1 with that in Mendall (1980) reveals no important differences in bill measurements of adult females between *borealis* and intergrades. As all available specimens of *sedentaria* were summer-collected, those two sets of data are the same. With *dresseri*, the data were grouped geographically in my earlier publication, with significant differences measured. Therefore, the present tabulation (Table 1) represents, broadly, a composite of the previous compilations, together with additional fall, winter, and early spring collections.

Multiple range tests by the S-N-K procedure of the data for males listed in Table 1 were slightly less specific than had been demonstrated (Mendall 1980) for adult females. The results are shown in Table 2.

Whereas the total bill length and nostril extension measurements had been about equally satisfactory in racial determination of adult females, only total length permitted complete separation of the three subspecies and *borealis-dresseri* intergrades among adult males. Considering the other two measurements, some overlap in means of the subsets occurred between *borealis* and intergrades, although the overlap was slight for the frontal extension. *Sedentaria* and adult *dresseri* separated from other races and from intergrades in all three measurements.

The overlap in means of each measurement between *sedentaria* and subadult and immature *dresseri* is not of much practical concern. On the basis of present knowledge of eider distribution, *sedentaria* is virtually restricted to Hudson Bay at all seasons of the year, whereas *dresseri* is not known to occur there. Thus, the locality of collection would seem to rule out uncertainty in distinguishing these two subspecies.

Figure 2
Bill processes of Common Eiders. (A) Adult males, *borealis* (left) and *dresseri* (right). (B) Typical adult females, from left to right: *dresseri*, *sedentaria*, *borealis*. (C) Adult males, from left to right: *dresseri*, atypical *borealis*, typical *borealis*. The shape of the frontal extension of this *dresseri* is more typical than that shown in (A). (D) Day-old ducklings, both males, *dresseri* (left) and *borealis* (right)

Lobes du bec des Eiders à duvet. (A) Mâles adultes, borealis (à gauche) et dresseri (à droite). (B) Femelles adultes typiques, de gauche à droite : dresseri, sedentaria, borealis. (C) Mâles adultes, de gauche à droite : dresseri, borealis non typiques, borealis typiques. La forme de l'extension frontale de ce dresseri est plus typique que celle montrée en (A). (D) Canetons d'une journée, mâles, dresseri (à gauche) et borealis (à droite)

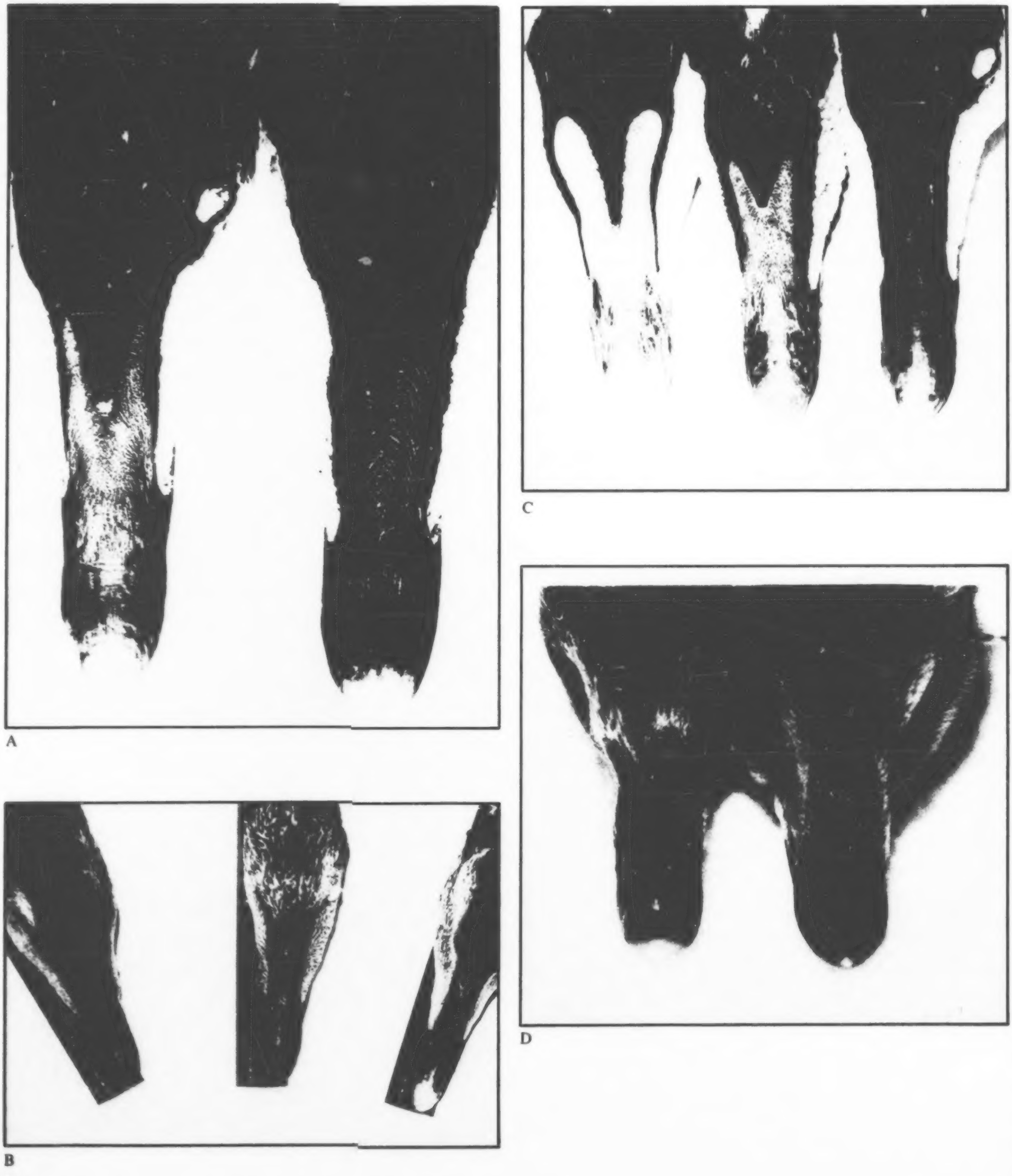
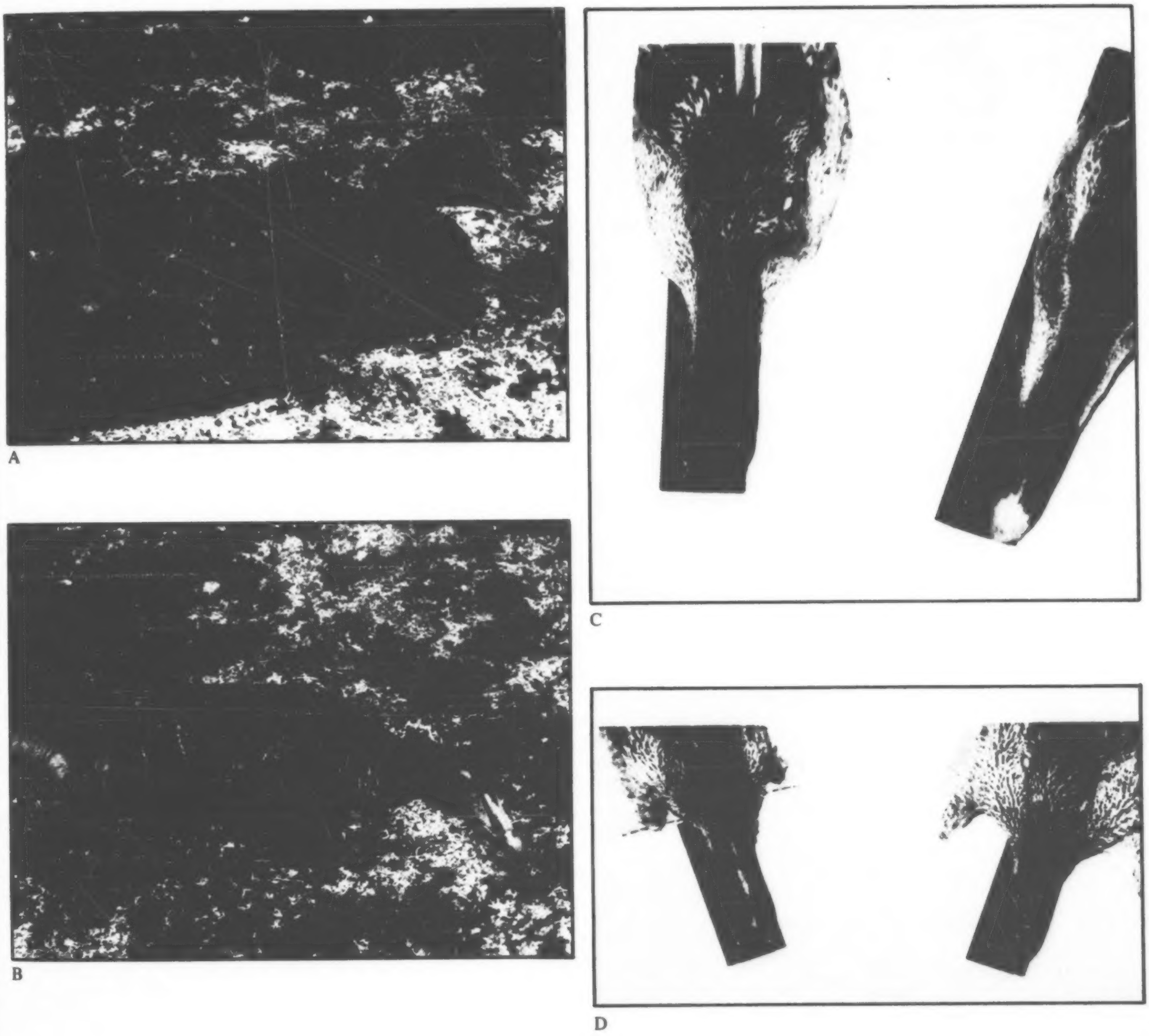


Figure 3
Bill processes of adult female Common Eiders. *Borealis-dresseri* intergrades show much variation in appearance. (A) Live-trapped *dresseri*. (B) Live-trapped intergrade. Note the position of the frontal extension in relation to the eye as compared to the *dresseri* in (A). (C) Intergrade (left) and typical *borealis* (right). (D) Gray-phase Labrador eiders, intergrade (left), and *borealis* (right)

Lobes du bec de femelles adultes de l'Eider à duvet. La sous-espèce intermédiaire borealis-dresseri démontre, en apparence, une plus grande variation. (A) Dresseri capturé vivant. (B) Sous-espèce intermédiaire capturée vivante. Remarquer la position de l'extension frontale par rapport à l'oeil comparativement au dresseri en (A). (C) Sous-espèce intermédiaire (à gauche) et borealis typique (à droite). (D) Eiders du Labrador en phase de coloration grise, sous-espèce intermédiaire (à gauche) et borealis (à droite)



6. Discussion

6.1. Plumage coloration and facial feature patterns □

As previously stated, plumage coloration and facial feather patterns are too variable to be of much help in racial determination. Considering adult females, summer-collected *sedentaria* usually have overall body plumage that is pale, washed-out gray, more so than is generally the case in other subspecies (Snyder 1941, Palmer 1976). But there were numerous exceptions among the museum specimens I examined, and I feel this character has minimal value. A number of live-trapped *borealis* from Labrador and summer-collected *borealis* from northwestern Greenland were as pale gray as several *sedentaria* in museum collections; moreover, some *sedentaria* lacked the "typical" paleness and tended toward gray-brown. My earlier paper (Mendall 1980) pointed out the variability occurring in *dresseri* and intergrades, as well as the importance of the bird's age (e.g., young adults breeding for the first time versus older adults), and of plumage wear and fading during summer.

With males, plumage is an even less satisfactory criterion, separation being based largely on the relative amount of greenish wash on the head.

The position of the nostril in relation to the lateral facial feathers has been used by some authors as one of the subspecific criteria. This was tested with 344 eiders of all sex and age groups (Mendall 1980), and I concluded it was of little assistance in racial determination.

6.2. Bill measurements and shape of frontal lobes □

A consideration of both the shape of the frontal lobes, and the measurements of the bill processes, will permit racial identification of most Common Eiders occurring in eastern Canada and northeastern United States. All three of the measurements described are helpful, although, with males, total length is best as it results in less overlap of ranges (Table 2). With females, total length and nostril extension are almost equally satisfactory.

To assist in identification of individual specimens, a key (App. 1) has been prepared as a supplement to Table 1. The key gives emphasis to total bill length, the most dependable parameter, followed by nostril extension, and then frontal extension and bill shape. Users should be cautioned that the key will not always prove completely reliable due to occasional atypical specimens; also because it is based, as are the data in Table 1, on a relatively small sample of males. The key was tested against the raw data used in the various compilations. It was very satisfactory when considering individual females, and appeared accurate with the majority of males as well. However, if a larger sample of males is available in the future, especially of intergrades and *sedentaria*, the ranges and means as given may require changes.

Judgement must, of course, still be called upon in many instances. A number of specimens will have measurements that are within the range of overlap in one or more of the categories. In such cases, classifying the shape of the frontal lobe, although more subjective and requiring prior experience, may be of greater help. The difference in shape between that of an atypical subspecies and that of an intergrade complicates identification in border-

Table 1

Means, standard deviations, and ranges of three bill measurements of Common Eiders collected at all seasons of the year

Moyennes ($\bar{X}$), écarts types (ET) *et distribution des trois paramètres des becs des Eiders à duvet capturés au cours de toutes les saisons de l'année*

			Bill measurements, mm *Paramètres des becs, mm*		
			Frontal extension *Extension frontale*	Nostril extension *Extension nasale*	Total length *Longueur totale*
		N	$\bar{X}$ ± SD (Range) $\bar{X}$ ± ET *(Distribution)*	$\bar{X}$ ± SD (Range) $\bar{X}$ ± ET *(Distribution)*	$\bar{X}$ ± SD (Range) $\bar{X}$ ± ET *(Distribution)*
Males (*N* = 134)	*borealis*, adult	26	18.87 ± 1.47	32.40 ± 1.90	68.23 ± 2.11
Mâles	*adulte*		(17–22)	(27.5–36)	(64–71.5)
	borealis-dresseri intergrade, adult	10	20.50 ± 1.67	33.00 ± 1.13	70.95 ± 2.06
	adulte		(18–22)	(31–34.5)	(66–73)
	sedentaria, adult	11	22.82 ± 1.55	40.96 ± 1.96	78.23 ± 2.63
	adulte		(20–24.5)	(38–44)	(75–82)
	dresseri, adult	49	28.03 ± 2.50	45.12 ± 2.78	81.96 ± 3.26
	adulte		(23–34.5)	(40–51)	(75–90)
	dresseri, sub-adult and immature*	38	24.08 ± 2.96	41.37 ± 2.65	78.12 ± 3.88
	*sous-adulte et juvénile**		(19–32)	(35–46)	(69–86)
Females (*N* = 318)	*borealis*, adult	86	17.12 ± 1.79	28.27 ± 2.22	63.40 ± 2.50
Femelles	*adulte*		(13.5–21)	(22–32.5)	(59–71)
	borealis-dresseri intergrade, adult	47	18.25 ± 2.15	31.48 ± 2.29	66.40 ± 2.37
	adulte		(14–23)	(27.5–36)	(62–72)
	sedentaria, adult	22	20.07 ± 1.96	34.80 ± 1.93	70.48 ± 2.03
	adulte		(17–23)	(31–39)	(67.5–74)
	dresseri, adult	163	22.16 ± 2.01	36.96 ± 1.94	72.66 ± 2.46
	adulte		(17.5–27)	(32–41.5)	(68–80)

* Includes only immatures taken after 1 November. This is an arbitrary date, selected to allow for relatively late physical development of some young of the year in a retarded breeding season.

* *Comprend seulement les juvéniles capturés après le 1er novembre. Cette date est arbitraire et a été choisie pour tenir compte du développement physique relativement tardif de quelques jeunes de l'année produits dans une saison de reproduction tardive.*

Table 2
Multiple range test for means of three bill measurements, in millimetres, of male Common Eiders ($N = 134$). (Solid lines under group means indicate homogenous subsets, no pairs of which have means that differ by more than the shortest significant range (95%) for a subset of that size)
Test de distribution multiple pour connaître les moyennes des trois paramètres des becs (en mm) du mâle de l'Eider à duvet ($N = 134$). (Les moyennes des groupes soulignées indiquent des sous-ensembles homogènes où aucun couple n'a une moyenne qui diffère de plus que la plus petite distribution significative (95 %) pour un sous-ensemble de cette taille)

Frontal extension *Extension frontale*	Group *Groupe*	*borealis*	intergrade* *intermédiaire**	*sedentaria*	s.a. & im.† *dresseri* *s.-a. & juv.†*	adult *dresseri* *adulte*
	Group mean *Moyenne du groupe*	18.87	20.50	22.82	24.08	28.03
Nostril extension *Extension nasale*	Group *Groupe*	*borealis*	intergrade *intermédiaire*	*sedentaria*	s.a. & im. *dresseri* *s.-a. & juv.*	adult *dresseri* *adulte*
	Group mean *Moyenne du groupe*	32.40	33.00	40.96	41.37	45.12
Total length *Longueur totale*	Group *Groupe*	*borealis*	intergrade *intermédiaire*	s.a. & im. *dresseri* *s.-a. & juv.*	*sedentaria*	adult *dresseri* *adulte*
	Group mean *Moyenne du groupe*	68.23	70.95	78.12	78.23	81.96

Borealis-dresseri intergrades.
Subadults; also immatures taken after 1 November.

* *Borealis-dresseri, sous-espèce intermédiaire.*
† *Sous-adultes; comprend aussi les juvéniles capturés après le 1er novembre.*

line cases. An example may be seen in the bill of the male eider shown in the center of Figure 2*c*. From the appearance of the frontal lobe, I was uncertain whether the bird was a slightly atypical *borealis* or an intergrade. The measurement of the nostril extension indicated it could be either. However, both the total length (the best measurement for males) and the frontal extension were slightly below the means for *borealis* and considerably lower than the means for intergrades. Thus, I concluded the bird was probably a *borealis*.

More variation is to be expected in shape of the frontal lobes of intergrades see Figure 3*b*, *c*, and *d* than in "pure" races. With any given intergrade, there is no certainty if the bird is the direct offspring of subspecific parents or if it may be several generations removed, and with disproportional genetic makeup.

Based on the eiders examined during this study, it appears that about 95% can be classified as to race with probable accuracy. From the standpoint of field or laboratory checks by wildlife biologists, this is likely to be adequate for most management purposes. To strive for greater accuracy would involve detailed taxonomic study, including skeletal characteristics, and access to a considerable amount of preserved material from numerous geographic regions.

7. Acknowledgments

Most of the data used in this paper were obtained during the study described in my earlier publication (Mendall 1980). That study was jointly sponsored by the Division of Law Enforcement of the United States Fish and Wildlife Service (USFWS) and the Maine Cooperative Wildlife Research Unit (University of Maine, Marine Department of Inland Fisheries and Wildlife, Wildlife Management Institute, and USFWS cooperating).

I especially appreciate the assistance of William Snow, former special agent, USFWS, during the Labrador work. Other USFWS agents who helped with Labrador studies were Howard Brown, Clyde Bolin, and the late Donald Blais. Assistance in measuring museum specimens was given by my wife, Emma Mendall; and by William Sarbello, Myrtle Bateman, and Carl Korschgen, former graduate students of the University of Maine. Pierre Dupuis and André Bourget, of CWS, made specimens available and assisted with measurements. Austin Reed, CWS suggested the key (Appendix 1), and assisted in its preparation. I am indebted to CWS biologist Douglas Gillespie for unpublished data. I thank the following museum personnel for access to collections: Charles Huntington, Raymond Paynter, Jr., Marshall Howe, Ross James, and Kenneth Parkes. Computer programming and statistical assistance was provided by Wayne Persons, University of Maine Computer Center. Maxine Horne kindly typed the manuscript.

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Appendix 1

A key to aid in determining races of Common Eiders (*Somateria mollissima*) of northeastern North America

Females

1. Total bill length	<62.0 mm			*borealis*
	>74.0 mm			*dresseri*
	62.0–67.5 mm		*borealis* or intergrade*	2
	67.6–72.0 mm		*borealis*, intergrade, *sedentaria*, or *dresseri*	3
	72.1–74.0 mm		*dresseri* or *sedentaria*	3;5
2. Nostril extension	*a*) <27.5 mm			*borealis*
	b) >32.5 mm			*intergrade*
	c) 27.5–32.5 mm	(*i*) frontal extension >21		*intergrade*
		(*ii*) frontal extension ≤21		4
3. Nostril extension	*a*) <31.0 mm		*borealis* or intergrade	2
	b) >39.0 mm			*dresseri*
	c) 31.0–36.0 mm	(*i*) frontal extension >23.0		*dresseri*
		(*ii*) frontal extension <17.0	*borealis* or intergrade	2
		(*iii*) frontal extension 17.0–23.0		4
	d) 36.1–39.0 mm	(*i*) frontal extension >23.0		*dresseri*
		(*ii*) frontal extension ≤23.0	*dresseri* or *sedentaria*	5
4. Bill process shape	*a*) narrow, usually acutely pointed			*borealis*
	b) broad, well rounded, usually long		*dresseri* or *sedentaria*	5
	c) not acutely pointed or well rounded; often narrow and/or short			intergrade
5. Geographic separation	*a*) specimen obtained in Hudson Bay region west or north of approximate intersection of longitude 75°E and latitude 55°N			*sedentaria*
	b) specimen obtained east or south of approximate intersection of longitude 75°E and latitude 55°N			*dresseri*

Males

1. Total bill length	<66.0 mm			*borealis*
	>82.0 mm			*dresseri*
	66.0–74.0 mm		*borealis*, intergrade or s.a. *dresseri*	2
	74.1–82.0 mm		*sedentaria* or *dresseri*	3;5
2. Nostril extension	*a*) <31.0 mm			*borealis*
	b) ≥31.0 mm	(*i*) frontal extension <18.0		*borealis*
		(*ii*) frontal extension >22.0		s.a. *dresseri*
		(*iii*) frontal extension 18.0–22.0	*borealis* or intergrade	4
3. Nostril extension	*a*) <40.0 mm		s.a. *dresseri* or *sedentaria*	5
	b) >44.0 mm			*dresseri*
	c) 40.0–44.0 mm	(*i*) frontal extension >24.5		*dresseri*
		(ii) frontal extension ≤24.5	*dresseri* or *sedentaria*	5
4. Bill process shape	*a*) narrow, usually acutely pointed			*borealis*
	b) broad, well rounded, usually long		*dresseri* or *sedentaria*	5
	c) not acutely pointed or well rounded; often narrow and/or short			intergrade
5. Geographic separation	*a*) specimen obtained in Hudson Bay region west or north of approximate intersection of longitude 75°E and latitude 55°N			*sedentaria*
	b) specimen obtained east or south of approximate intersection of longitude 75°E and latitude 55°N			*dresseri*

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* Refers to *borealis-dresseri* intergrades throughout.

† As explained in the text, male *dresseri* require separate age tabulations. In this key, subadults (s.a.) also include birds of the year (immatures) taken after 1 November.

Sous-espèces d'Eider à duvet hivernant dans le golfe du Saint-Laurent

Races of the Common Eider wintering in the Gulf of St. Lawrence

A. Reed
P. Dupuis
A. Bourget
H.L. Mendall

1. Résumé

D'après la forme du lobe frontal et les mensurations du bec de 213 Eiders à duvet provenant du golfe du Saint-Laurent entre décembre et avril, 92 d'entre eux (43 %) appartenaient à la sous-espèce *Somateria mollissima dresseri* et 78 (37 %) à *S.m. borealis*, les autres (43, soit 20 %), étant des individus de la forme intermédiaire *borealis–dresseri*. Il y a lieu de croire que les fortes concentrations d'eider dans le complexe île d'Anticosti–archipel de Mingan en janvier et février renferment probablement une plus grande proportion d'eiders *S.m. borealis* (probablement >50 %), par suite de la migration vers le sud d'eiders *S.m. dresseri* à la fin de l'automne et de l'arrivée tardive d'eiders *S.m. borealis*. Les eiders *S.m. borealis* qui hivernent dans le golfe du Saint-Laurent proviendraient essentiellement de colonies de nidification situées dans le nord du Labrador et près du détroit d'Hudson, alors que les eiders de la forme intermédiaire viendraient pour la plupart du centre et du centre-sud du Labrador et que les eiders de la sous-espèce *dresseri* seraient surtout originaires du golfe du Saint-Laurent et de la partie centrale sud du Labrador ainsi qu'un certain nombre (mâles) de l'estuaire du Saint-Laurent.

2. Abstract

On the basis of bill measurements and frontal lobe shape of 213 Common Eiders obtained during winter (December to April) in the Gulf of St. Lawrence, it was determined that 92 (43%) were American Eiders (*Somateria mollissima dresseri*), 78 (37%) were Northern Eiders (*S.m. borealis*), and the remainder (43 birds, 20%) represented *borealis-dresseri* intergrades. The large concentrations in the Anticosti–Mingan Islands area in January and February are believed to have a higher proportion of *S.m. borealis* (probably >50%), resulting from the late fall departure of *S.m. dresseri* and the late arrival of *S.m. borealis*. *S.m. borealis* found in the gulf in winter probably originate from breeding colonies in northern Labrador and near Hudson Strait, the intergrades from central and south-central Labrador, and the *S.m. dresseri* from the Gulf of St. Lawrence and south-central Labrador as well as some males from the St. Lawrence estuary.

3. Introduction

Le golfe du Saint-Laurent a la réputation d'héberger un grand nombre d'Eiders à duvet durant l'hiver (Reed et Bourget, 1977; Bourget *et al.*, présente publication). La composition par sous-espèce de cette population d'hivernants a été étudiée en premier par Beetz (1916), mais plusieurs aspects demeurent encore obscurs. Grâce à la recapture d'oiseaux bagués, Cooch (1965) a montré que des individus de la sous-espèce *Somateria mollissima borealis* peuvent passer l'hiver dans le golfe près de la Côte-Nord; l'examen par Ouellet (1975) d'individus capturés en hiver près de la pointe de la péninsule de Gaspé dans la partie sud-ouest du golfe y révèle la présence de *S.m. borealis* et de *S.m. dresseri*. En été, la région est occupée par une population nicheuse de *S.m. dresseri* (Palmer, 1976).

Il importe, pour les besoins d'aménagement, de connaître la composition par sous-espèce du groupe d'eiders qui hivernent dans le golfe, car c'est un lieu où la chasse sportive à l'eider est intense (Wendt et Silieff, présente publication) et que certains de ces eiders peuvent venir de populations qui passent l'été dans le nord, où la chasse de subsistance est aussi intense (Comité de recherche sur les prises des autochtones de la Baie James et du Nord québécois, 1982). Nous examinerons ici la composition par sous-espèce du troupeau d'eiders hivernant dans le golfe d'après la taille du bec et la forme du lobe frontal d'un échantillon de spécimens de musée et d'oiseaux abattus par des chasseurs.

4. Échantillon et méthodes

Nous avons analysé 175 eiders confisqués par des agents de conservation du Québec à des chasseurs qui les auraient illégalement abattus au cours de l'hiver (décembre à avril) de 1976 à 1983 sur la côte nord du golfe et dans la partie adjacente de l'estuaire. Comme certaines des étiquettes d'identification ne portaient que la date et le lieu de la confiscation et que quelques-unes des saisies avaient eu lieu bien après la chasse, nous n'avons pu déterminer la date et l'endroit précis où chaque oiseau avait été tué. Nous sommes toutefois persuadés que la plupart des oiseaux ont été pris sur la Côte-Nord, des Escoumins à Natashquan (voir figure 1 dans Bourget *et al.*, présente publication), mais nous ne pouvons pas exclure la possibilité qu'on nous ait involontairement remis quelques captures du printemps. Nous avons aussi examiné 17 peaux d'eider (datées de décembre à février 1914 à 1980) conservées par les Musées nationaux à Ottawa et 21 oiseaux fraîchement capturés par M. Guillemette en mars 1984.

Les sous-espèces d'Eider à duvet se distinguent entre elles par, entre autres, des différences subtiles de taille, de coloration du plumage et surtout par la forme et les dimensions du bec (Palmer, 1976; Mendall, 1980). Nous avons déterminé la sous-espèce de chacun de nos spécimens d'après la clé développée par Mendall (présente publication) qui est fondée sur des mensurations du bec et la forme du lobe frontal.

5. Résultats et analyse

L'échantillon comprenait au total 43 % de *S.m. dresseri*, 37 % de *S.m. borealis* et 20 % de la forme intermédiaire *borealis-dresseri* (tableau 1).

L'échantillon complet était peut-être représentatif de la période de décembre à mars, mais probablement pas pour le coeur de l'hiver (fin janvier et février), où les populations sont à leur maximum (Bourget *et al.*, présente publication). Nous soupçonnons que notre échantillon d'oiseaux confisqués sur la Côte-Nord, sans date de capture, renfermait une proportion anormalement élevée d'eiders capturés en décembre et surtout en mars et avril, mois où les conditions météorologiques et l'état des

Troupeau d'eiders au large de la côte nord du golfe du Saint-Laurent en mars 1977
Flock of eiders off the north shore of the Gulf of St. Lawrence in March 1977
(photo: P. Dupuis)

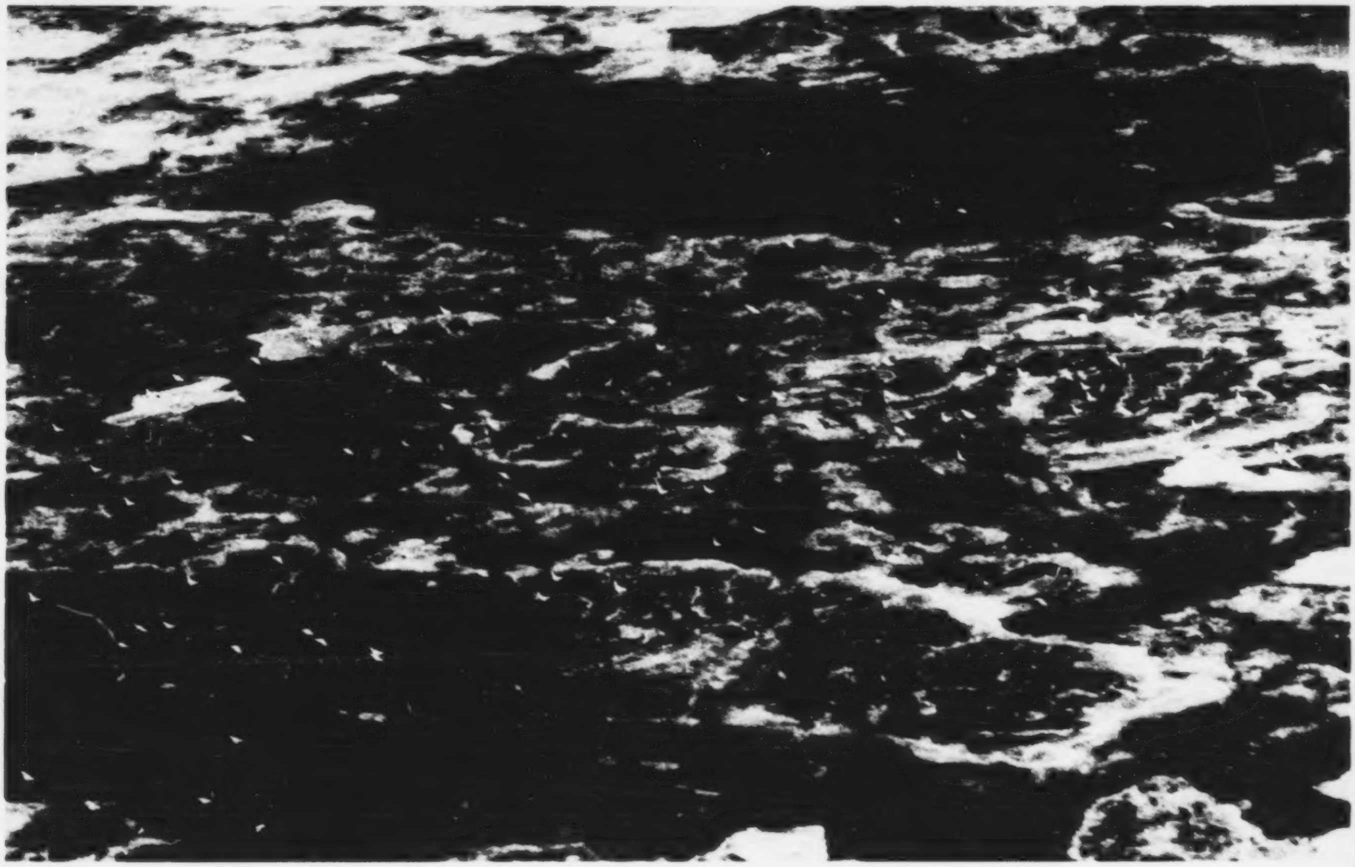

Tableau 1
Composition des sous-espèces à partir d'un échantillon de 213 Eiders à duvet provenant du golfe du Saint-Laurent en hiver
Racial composition of a sample of 213 Common Eiders wintering in the Gulf of St. Lawrence

Régions *Locations*	*Somateria mollissima borealis*		*S.m. borealis–dresseri*		*S.m. dresseri*	
	♂	♀	♂	♀	♂	♀
Côte-Nord	39	35	23	16	56	24
Îles-de-la-Madeleine, Gaspé, Baie des Chaleurs	0	4	2	2	7	5

glaces gênent moins l'activité des braconniers; bon nombre de ces eiders étaient sans doute des individus de la sous-espèce *dresseri*, originaires des colonies de nidification du golfe du Saint-Laurent et du centre-sud du Labrador, qui utilisent la région comme une halte migratoire seulement. Au plus fort de l'hiver, beaucoup de ces eiders *S.m. dresseri* étaient vraisemblablement allés séjourner plus au sud et remplacés par un grand nombre d'eiders *S.m. borealis*, arrivés tardivement. Aussi croit-on que ces eiders (*S.m. borealis*) représentent une plus grande proportion dans les concentrations de la mi-hiver (sans doute plus de 50 %) au large de l'île d'Anticosti et de l'archipel de Mingan que ne l'indique notre échantillon.

Les eiders de la sous-espèce *borealis*, qu'on trouve en hiver dans le golfe, proviennent sans doute de colonies de nidification réparties sur une vaste aire englobant le nord du Labrador et le détroit d'Hudson. Cette hypothèse n'est toutefois appuyée que par la recapture, sur la côte nord du golfe, d'un seul eider bagué dans une colonie de nidification située dans le nord-ouest du détroit d'Hudson (Cooch, 1965). Il est logique de conclure que les intermédiaires *borealis–dresseri* sont originaires de la partie centrale et du centre-sud du Labrador, la seul aire connue de nidification de cette forme (Mendall, 1980). Les eiders *S.m. dresseri* viennent vraisemblablement de colonies établies dans le centre-sud du Labrador (cette hypothèse est appuyée par la recapture dans le golfe d'un eider bagué au centre-sud du Labrador : registres de baguage inédits) et dans le golfe du Saint-Laurent; il est possible que quelques mâles adultes, étant venus d'ailleurs pour la mue estivale, y demeurent une partie de l'hiver.

Notre échantillon comprenait beaucoup plus de mâles que de femelles, le rapport étant de 1,48 : 1 ($n = 213$, $\text{Chi}^2 = 7{,}51$, $p < 0{,}01$). Ce rapport n'est pas significativement différent de celui de 1,36 : 1 établi par Bourget *et al.* (présente publication) d'après un échantillon photographique de 21 761 eiders vivants réalisé au large de l'île d'Anticosti en février 1980 ($\text{Chi}^2 = 0{,}33$, $p > 0{,}05$). Dans notre échantillon, les *S.m. borealis* et les intermédiaires (*borealis–dresseri*) accusaient une proportion à peu près égale des sexes ($\text{Chi}^2 = 0{,}08$ et $0{,}01$, $p > 0{,}05$), mais il y avait une prépondérance marquée des mâles chez les *S.m. dresseri* (2,17 : 1, $\text{Chi}^2 = 11{,}84$, $p < 0{,}01$); il se peut que cet «excédent» de mâles soit constitué de sujets venant des colonies de nidification de l'estuaire du Saint-Laurent pour effectuer la mue (il y a eu recapture directe en automne sur la côte nord du golfe d'un mâle adulte bagué dans une colonie de nidification de l'estuaire : registres de baguage inédits) et d'ailleurs.

La présente étude montre que l'examen minutieux des eiders en hivernage peut fournir des indices précieux sur leurs sites de nidification. Toutefois, pour les besoins d'aménagement et de conservation, il serait bon de dresser un tableau plus complet des diverses populations qui hivernent le long du littoral atlantique. Nous recommandons de poursuivre l'étude des groupes qui passent l'hiver dans le golfe, à Terre-Neuve et dans les Maritimes, en mettant l'accent sur la période de janvier–février où les mouvements migratoires sont à leur minimum.

6. Remerciements

Nous sommes reconnaissants aux agents de conservation H. Huart, C. Lapointe et R. Plouffe du ministère québécois du Loisir, de la Chasse et de la Pêche de nous avoir fourni des eiders confisqués. Nous tenons également à remercier H. Ouellet et M. Gosselin qui ont facilité notre étude des spécimens du Musée national des sciences naturelles à Ottawa, ainsi que Magella Guillemette qui a aimablement mis ses captures à notre disposition.

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Part III Distribution in winter

Section III Distribution pendant l'hiver

(photo: F. Bruemmer)

Les eiders hivernant dans le golfe du Saint-Laurent : effectifs et distribution

Eiders wintering in the Gulf of St. Lawrence: numbers and distribution

A. Bourget
P. Dupuis
W.R. Whitman

1. Résumé

Des inventaires aériens effectués en février 1980 dans le golfe du Saint-Laurent ont révélé la présence d'environ 155 000 eiders. Plus de 95 % d'entre eux se retrouvaient dans le complexe île d'Anticosti–archipel de Mingan. L'Eider à duvet (*Somateria mollissima*) constituait 97,5 % des effectifs, les autres étant des Eiders remarquables (*S. spectabilis*). Le golfe du Saint-Laurent supporte environ 31 % des effectifs d'eider qui hivernent sur la côte est du continent nord-américain.

2. Abstract

Aerial surveys conducted in the Gulf of St. Lawrence in February 1980 indicated the presence of approximately 155 000 eiders, of which more than 95% were concentrated in the region of Anticosti Island – Mingan Islands. Common Eiders (*Somateria mollissima*) made up 97.5% of the flock, the remainder being King Eiders (*S. spectabilis*). The Gulf of St. Lawrence sustains approximately 31% of the eider population overwintering along the coasts of eastern North America.

3. Introduction

Le golfe du Saint-Laurent représente en tout temps de l'année une région importante pour plusieurs espèces d'oiseaux aquatiques. Pour la période hivernale, Reed et Bourget (1977) ont démontré l'importance de la côte nord du golfe pour les anatidés, dont l'Eider à duvet (*Somateria mollissima*). Le présent article vise à préciser, grâce à des relevés récents, la situation de cette espèce dans l'ensemble du golfe du Saint-Laurent en hiver.

4. Région à l'étude et méthodes

Le climat hivernal du golfe du Saint-Laurent est rigoureux. À titre d'exemple, les températures moyennes des mois de décembre à mars à Sept-Îles sont de −12, −14, −13 et −7°C (Villeneuve, 1967). Des glaces se fixent le long du littoral chaque hiver et il y a formation de champs de glaces flottantes; leur recouvrement atteint son maximum au mois de février.

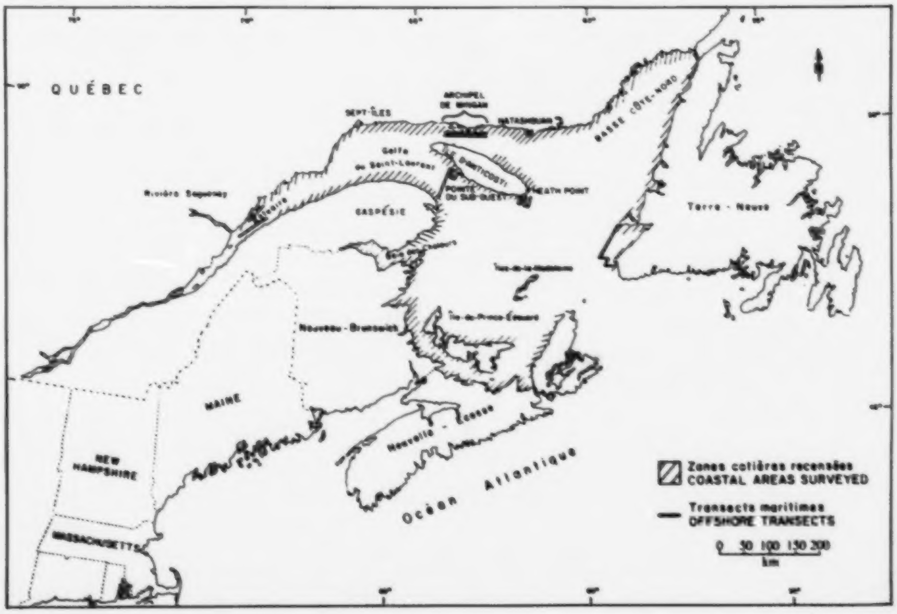
L'étendue et la distribution de ce recouvrement varient d'année en année, selon les températures, la vélocité et la direction des vents (Black, 1963; Markham, 1980). Les courants et les vents assurent, néanmoins, la présence de surfaces d'eau libres de glaces à tous les ans.

De la fin janvier à la mi-février 1980, nous avons effectué un inventaire aérien systématique de l'ensemble du golfe du Saint-Laurent. Deux équipes de deux observateurs ont survolé les côtes du littoral et des îles (figure 1). L'équipe du Service canadien de la faune (SCF) — Région du Québec, a réalisé l'inventaire des rives de l'estuaire et de ses îles, de la côte nord du golfe, de l'île d'Anticosti, de la côte ouest de Terre-Neuve et de la rive nord de la péninsule gaspésienne. Le survol des côtes de l'Île-du-Prince-Édouard, du Nouveau-Brunswick, de la baie des Chaleurs, de la Nouvelle-Écosse et du sud de Terre-Neuve a été effectué par le personnel du SCF — Région de l'Atlantique.

Les virées dans toutes les régions longeaient les côtes ou les champs de glaces accumulées le long du littoral, à une distance variant de 100 à 300 m au large de la limite des eaux. Une série de virées plus au large permettaient d'échantillonner quelques sites marins du golfe et de l'estuaire.

Nous avons utilisé pour les transects maritimes et les côtes du Québec et de Terre-Neuve, un bimoteur à ailes surélevées (Cessna 337 Skymaster) et pour les survols des provinces maritimes, des monomoteurs (Cessna 172 et 185). La vitesse variait entre 120 et 200 km/h et l'altitude de 100 à 180 m. À bord des avions, deux observateurs enregistraient sur cas-

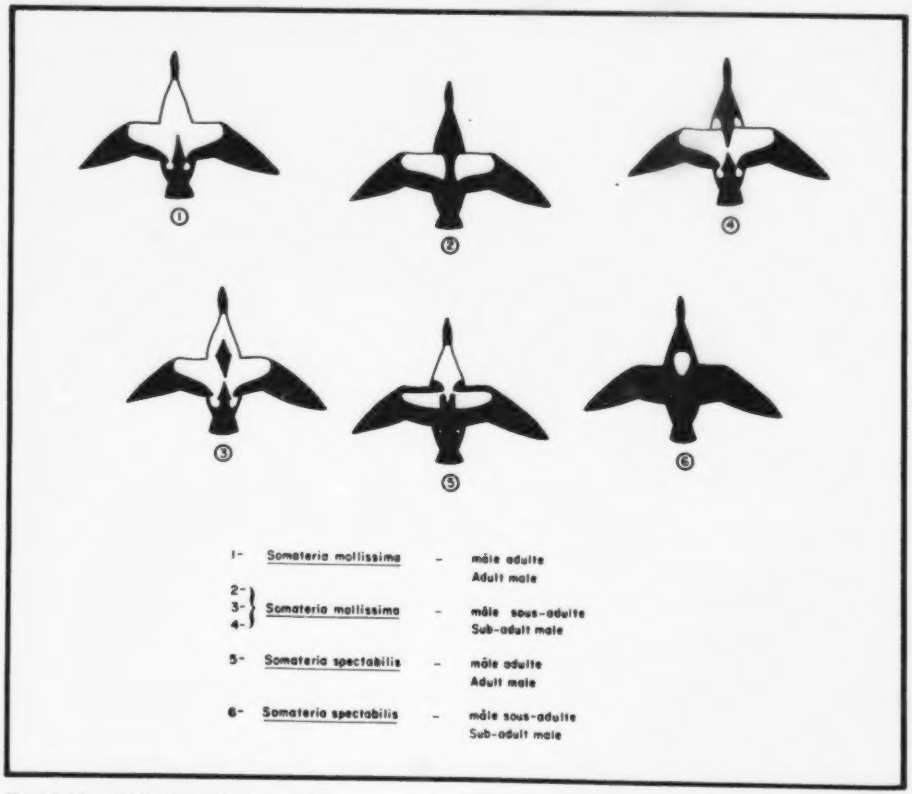
Figure 1
Golfe du Saint-Laurent montrant les zones côtières et maritimes recensées, février 1980
Gulf of St. Lawrence showing coastal and offshore areas surveyed, February 1980


QUÉBEC
ARCHIPEL DE MINGAN
SEPT-ÎLES
NATASHQUAN
BASSE CÔTE-NORD
Golfe du Saint-Laurent
D'ANTICOSTI
POINTE DU SUD-OUEST
HEATH POINT
Rivière Saguenay
GASPÉSIE
Terre - Neuve
Îles-de-la-Madeleine
Île-du-Prince-Édouard
Nouveau-Brunswick
MAINE
NEW HAMPSHIRE
MASSACHUSETTS
Nouvelle - Écosse
Océan Atlantique
Zones côtières recensées
COASTAL AREAS SURVEYED
Transects maritimes
OFFSHORE TRANSECTS
0 50 100 150 200
km

sette magnétoscopique les oiseaux vus de chaque côté de l'aéronef, notaient l'espèce et estimaient le nombre d'oiseaux dans chacun des groupes. Dans le cas des bandes de plus de 1000 eiders, ils enregistraient chacun une estimation, utilisée par la suite pour obtenir la moyenne à être retenue comme évaluation finale. Ces mêmes regroupements ont été photographiés, obliquement et à basse altitude, à l'aide d'une caméra 35 mm (Minolta) motorisée et équipée d'un téléobjectif 135 mm. Ces échantillons photographiques servaient à déterminer la proportion des espèces (Eider à duvet vs Eider remarquable *S. spectabilis*) et les catégories de plumage (type mâle vs type femelle). Nous avons préparé un guide d'interprétation (figure 2) pour faciliter l'identification des espèces et des catégories de plumage sur les imprimés photographiques, en nous basant sur les illustrations fournies dans Cramp (1977).

Enfin, nous présentons les résultats d'autres relevés partiels réalisés dans le golfe du Saint-Laurent entre 1974 et 1979, pour illustrer les changements de distribution qui se font au cours de l'hiver. Aussi, nous faisons référence à d'autres relevés d'eiders dans l'Atlantique occidental afin de placer nos résultats dans un contexte plus global.

Figure 2
Interprétation graphique des types de plumage du mâle de l'eider utilisés pour l'analyse des photos aériennes
Graphic interpretation of plumage type of male eiders used for analysis of aerial photos


①
②
④
③
⑤
⑥
1- Somateria mollissima - mâle adulte Adult male
2- 3- 4- Somateria mollissima - mâle sous-adulte Sub-adult male
5- Somateria spectabilis - mâle adulte Adult male
6- Somateria spectabilis - mâle sous-adulte Sub-adult male

Note: Les femelles des deux espèces apparaissent brun uniforme du haut des airs et ne peuvent être séparées. Les catégories 2, 3, 4 et 6 représentent des oiseaux âgés de 6 à 8 mois, sauf quelques individus de la catégorie 4 qui peuvent avoir de 18 à 20 mois (voir Palmer, 1976).

Note: From the air, females of both species appear uniformly brown and cannot be identified to species. Categories 2, 3, 4, and 6 represent 6–8 month-old birds, although some individuals in category 4 can be 18–20 months old (see Palmer 1976).

5. Résultats et analyse

5.1. Effectifs et distribution □

Les inventaires aériens de 1980 permettent d'estimer les effectifs d'eider hivernant dans le golfe du Saint-Laurent à environ 155 000 (tableau 1). Des inventaires effectués aux États-Unis la même année, démontrent des nombres légèrement supérieurs (tableau 2). En 1980, nous n'avons pas recensé les côtes atlantiques de Terre-Neuve mais des relevés plus récents (Whitman et Goudie, rapp. inédit) indiquent une population du même ordre de grandeur que celle du golfe et de la côte de la Nouvelle-Angleterre (tableau 2).

Plus de 95 % des eiders du golfe du Saint-Laurent se rencontrent dans des régions bien restreintes, soit l'archipel de Mingan et l'île d'Anticosti (figure 3). En effet, l'archipel de Mingan accueille presque les deux tiers des eiders hivernant dans le golfe (tableau 1). Constitué de 39 îles et îlots, cet archipel réunit plusieurs éléments nécessaires à l'hivernage de l'eider : des secteurs généralement libres de glaces à cause des courants (Simpson, 1973), l'inaccessibilité de plusieurs îles et hauts fonds à cette époque de l'année et enfin, une productivité biologique considérable (Dunbar, 1979) dont une importante composante d'invertébrés benthiques (Fradette et Bourget, 1980) favorisée par la rencontre de l'eau salée et de l'eau douce provenant des rivières se déversant au nord des îles. L'abondance et la diversité de l'avifaune en période de reproduction et la présence de grands cétacés au même moment de l'année témoignent aussi de la richesse écologique de ce milieu (Chapdelaine et Bourget, 1981).

La deuxième région d'importance pour l'eider dans le golfe du Saint-Laurent est l'île d'Anticosti, avec un tiers des eiders recensés en 1980 (tableau 1). Peu d'oiseaux fréquentent la rive nord de l'île qui est exposée aux vents dominants et souvent recouverte de champs de glaces. La rive sud est généralement plus dégagée de glaces et les eiders s'y concentrent en grosses bandes. Cette partie de l'île est d'ailleurs la seule région de tout le golfe où nous avons repéré des groupes d'eiders le long des transects maritimes (jusqu'à 15 km au large de l'île). Soixante-douze pour cent des eiders de l'île d'Anticosti proviennent de secteurs localisés au large des côtes, plus particulièrement à la pointe du Sud-Ouest et à la pointe Heath (tableau 1, figure 1). Des inventaires effectués en 1974, 1976 et 1980 (tableau 1) suggèrent que l'île d'Anticosti accueille chaque année, une proportion similaire, soit entre 31 et 35 % des effectifs de la partie nord du golfe du Saint-Laurent.

Les eiders sont moins abondants en d'autres régions du golfe en hiver. En 1980, nous n'y avons localisé que quelques petits groupes (tableau 2, figure 3). Nous en avons rencontré à l'occasion ailleurs le long de la Côte-Nord comme en janvier 1974 (tableau 1). Cette situation semble refléter un éparpillement des oiseaux au début de l'hiver avant qu'ils se réunissent dans les îles Mingan. Le tableau 3, basé sur une série de relevés en 1978–1979, démontre une plus grande dispersion des eiders en novembre, leur polarisation dans l'archipel de Mingan commençant en décembre, et une dispersion rapide en avril avec l'approche de la saison de nidification.

Figure 3
Principaux sites de concentration des eiders dans le golfe du Saint-Laurent, hiver de 1980
Principal eider concentrations in the Gulf of St. Lawrence, winter 1980

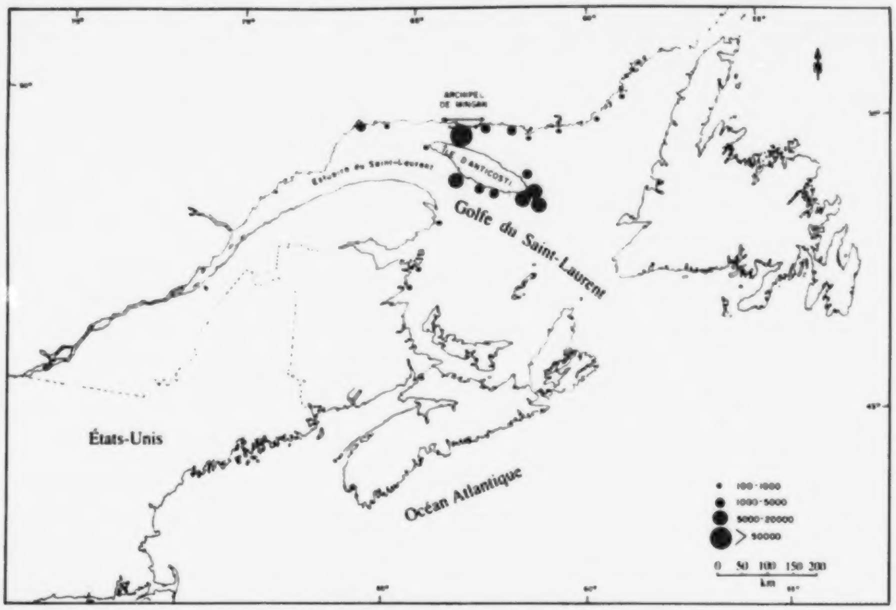

ARCHIPEL DE MINGAN
ÎLE D'ANTICOSTI
Estuaire du Saint-Laurent
Golfe du Saint-Laurent
États-Unis
Océan Atlantique
● 100-1000
● 1000-5000
● 5000-20000
● > 50000
0 50 100 150 200
km

Tableau 1
Nombre d'eiders observés dans le golfe du Saint-Laurent en hiver, 1974 à 1980
Number of eiders observed in the Gulf of St. Lawrence in winter, 1974–80

Régions	5 janv. au 5 fév. 1974	14 au 21 janv. 1975	6 au 8 fév. 1976	15 au 16 fév. 1978	20 janv. 1979	29 janv. au 2 fév. 1980
Côte-Nord						
Baie de Sept-Îles	155	—*	1	25	0	880
Sept-Îles–Archipel de Mingan	1 011	6 335	120	505	53	532
Archipel de Mingan	35 995	—	50 979	77 299	51 696	96 739
Archipel de Mingan–Natashquan	21 268	5 472	7 760	1 456	727	1 212
Basse Côte-Nord	—	—	3 202	1 366	1	890
Sous-total *Subtotal*	58 429	11 807	62 062	80 651	52 477	100 253
Île d'Anticosti						
Pointe est	5 600	—	25 386	—	—	8 925‡
Rive sud	9 354	—	3 403	—	—	43 349 (38 040)
Pointe ouest	11 432	—	—	—	—	615
Rive nord	0	—	181	—	—	
Sous-total *Subtotal*	26 386	—	28 970	—	—	52 890
Reste du golfe						
Gaspésie (Baie des Chaleurs)	14†	0	505	—	—	198
Îles-de-la-Madeleine	—	—	—	—	—	18
Estuaire (Saguenay–Sept-Îles)	—	0	1	—	—	437
Nouveau-Brunswick (côte est)	—	—	—	—	—	599
Nouvelle-Écosse	—	—	—	—	—	5
Île-du-Prince-Édouard	0	—	—	—	—	0
Terre-Neuve (côte ouest)	—	—	—	—	—	50
Sous-total *Subtotal*	14	—	506	—	—	1 307
Total	84 829	11 807	91 538	80 651	52 477	154 450

*Non recensé.
†Inventaire au sol.
‡Le nombre enregistré en transects maritimes apparaît entre parenthèses et est inclus dans le total.

* *Not surveyed.*
† *Ground count.*
‡ *Number recorded on offshore transects is indicated in brackets and is included in total.*

Tableau 2

Effectifs hivernaux des eiders de l'est de l'Amérique du Nord, au sud du 52° N

Number of wintering eiders in eastern North America, south of 52° N

Endroits *Locations*	Dénombrements visuels *Visual counts*	Estimations (arrondies au 100) *Estimates (rounded to nearest 100)*	Référence *Observer or source*
Golfe du Saint-Laurent			
Québec			Dupuis et Bourget, 1982 (hiver de 1980)
Côte-Nord et estuaire	100 690		
Île d'Anticosti	52 890		
Gaspésie	198		
Nouveau-Brunswick	599		
Nouvelle-Écosse	5		
Î.-P.-É. et Îles-de-la-Madelaine	18		
Terre-Neuve (côte ouest)	50		
Sous-total *Subtotal*		154 500	
Côte Atlantique (Canada)			
Terre-Neuve (côte est et sud-est)	150 000*		Whitman et Goudie, rapp. inédit (hiver 1982)
Terre-Neuve (côte sud-ouest)	2 210		Whitman, 1980 (hiver de 1980)
Nouvelle-Écosse	2 404		Whitman, 1980 (hiver de 1980)
Nouveau-Brunswick	2 449		Whitman, 1980 (hiver de 1980)
Sous-total *Subtotal*		157 100	
Côte Atlantique (États-Unis)			
Maine	81 240		Spencer *et al.*, 1982 (hiver de 1980)
New Hampshire	680		USFWS, 1980 (hiver de 1980)
Massachussetts	98 900		USFWS, 1980 (hiver de 1980)
Sous-total *Subtotal*		180 800	
Total		492 400	

*Calcul approximatif. * *Approximate data.*

Tableau 3

Distribution des eiders sur la Côte-Nord en dehors de la saison de reproduction, 1978–1979

Distribution of eiders along the north shore of the St. Lawrence outside of the breeding season, 1978–79

	Pourcentage des effectifs par région *Percentage of birds by region*					
Régions	21 nov. 1978	12 déc. 1978	20 jan. 1979	15–16 fév. 1978	16–17 mars 1978	10 avril 1978
Baie de Sept-Îles	0	0	0	tr.	0	5,2
Sept-Îles–archipel de Mingan	36,2	6,5	0,1	0,6	0,6	61,8
Archipel de Mingan	45,9	80,8	98,5	95,8	99,3	5,2
Archipel de Mingan–Natashquan	15,6	10,0	1,4	1,8	0,1	22,6
Basse Côte-Nord	2,3	2,8	tr.	1,7	0	5,1
Nombre total d'eiders recensés *Total number of eiders observed*	8665	23 769	52 477	80 651	100 123	1339

Troupeau d'eiders au large de la côte nord du fleuve Saint-Laurent en mars 1977. Sur la diapo couleur originale, on a dénombré 356 Eiders à duvet mâles, 78 Eiders remarquables mâles et 204 eiders femelles. Les femelles de l'Eider à duvet et de l'Eider remarquable ne peuvent être différenciées lors des relevés aériens
Flock of eiders off the north shore of the Gulf of St. Lawrence in March 1977. On the original colour slide 365 male Common Eiders, 78 male King Eiders, and 204 female eiders were counted. The females of Common and King Eiders can not be distinguished during aerial surveys
(photo: P. Dupuis)

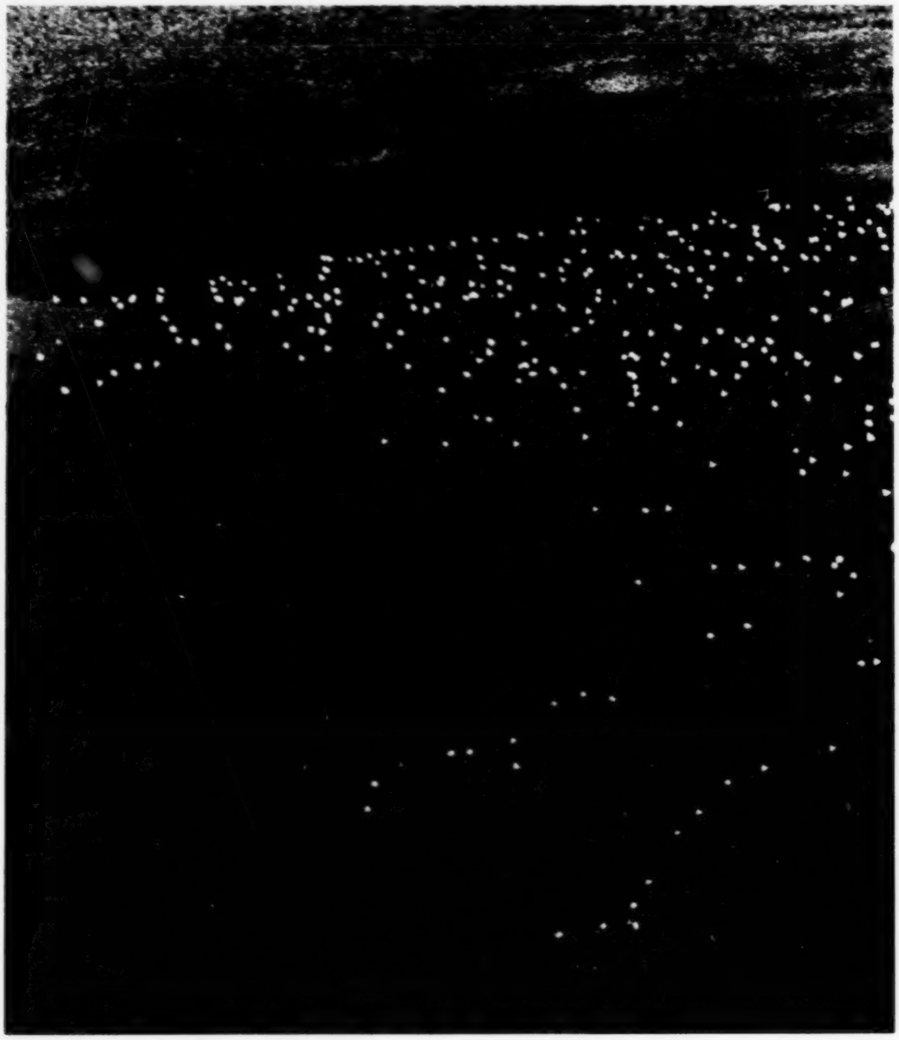


Tableau 4
Taille des groupes d'eiders observés dans le golfe du Saint-Laurent, hiver de 1980
Size of groups of eiders observed in the Gulf of St. Lawrence, winter 1980

	Taille des groupes *Size of groups*		
	1 à 299	300 à 999	>1000
Nombre d'oiseaux et (groupes) observés *Number of birds and (groups) observed*	5896 (120)	12 150 (30)	135 750 (32)
Pourcentage d'oiseaux et (groupes) *Percentage of birds and (groups)*	4 (66)	8 (16)	88 (18)
Nombre moyen d'oiseaux par groupe *Mean number of birds per group*	49	405	4 242

L'eider est reconnu pour son grégarisme. Nos recensements aériens illustrent ce comportement durant l'hiver. En 1980, nous avons rencontré des groupes d'eiders variant de quelques individus jusqu'à 17 000. Quatre-vingt-huit pour cent des eiders se retrouvaient en 32 bandes de plus de 1000 individus (tableau 4).

Il est probable que nous avions sous-évalué le nombre d'eiders dans certains groupes de grande taille, et n'avons pas décelé tous les groupes présents dans le golfe. Cependant, nous considérons notre estimation comme étant d'un bon ordre de grandeur et amplement précise pour des fins de comparaison avec d'autres études.

5.2. Composition des groupes □

Les photos aériennes permettent de déterminer avec plus de précision la composition des espèces, des sexes et des âges du groupe (tableau 5, figure 2). Parmi les 12 550 mâles dénombrés sur les photos, seulement 203 (1,6 %) étaient des Eiders remarquables. Par extrapolation, nous estimons les effectifs de cette espèce dans le golfe du Saint-Laurent à 2500 individus. Chez les mâles de l'Eider à duvet, nous avons décelé la présence de 3,8 % (*n* = 12 347) de sous-adultes et chez l'Eider remarquable 4,9 % (*n* = 203). Pour l'ensemble des deux espèces, nous estimons un rapport de 1,36 mâle pour chaque femelle (*n* = 21 761). Des estimations visuelles des différents types de plumage ont été effectuées sur un certain nombre de groupes lors du même inventaire. Ces estimations ont sous-évalué les rapports entre l'Eider remarquable et l'Eider à duvet et entre mâle et femelle, et elles n'ont pas indiqué la présence de sous-adultes (tableau 5).

6. Conclusion

Trente et un pour cent de tous les eiders hivernant dans l'est du continent au sud du 55°N se retrouvent dans le golfe (tableau 2). Nos recensements ont confirmé l'importance des rassemblements d'eiders dans le complexe île d'Anticosti–archipel de Mingan signalé par Reed et Bourget (1977), et n'ont pas révélé la présence d'autres sites importants. Ni les côtes de Terre-Neuve ni le golfe du Saint-Laurent ne semblent accueillir les effectifs d'environ 2 000 000 eiders avancés par L. Tuck (*dans* Gillespie et Learning, 1974).

Dans le golfe, les eiders se rassemblent progressivement au cours de l'hiver pour former d'immenses regroupements dans l'archipel de Mingan et près de l'île d'Anticosti. La concentration d'une forte proportion des effectifs dans quelques secteurs restreints de l'aire d'hivernage rend les oiseaux vulnérables à la pollution ou à la dégradation des habitats. Il en est ainsi

Tableau 5
Composition des regroupements d'eiders hivernant dans le complexe île d'Anticosti – archipel de Mingan, hiver de 1980
Composition of eider flocks wintering in the Mingan–Anticosti area, winter 1980

Espèce et plumage *Species and plumage*	N° de référence *Reference no.* (figure 2)	Estimations visuelles *Visual estimates*	Décompte photographique *Photo count* (*n* = 44)
Eider à duvet adulte ♂ *Common Eider adult ♂*	1	42 190	11 877
Eider à duvet sous-adulte* ♂ *Common Eider subadult* ♂*	2,3,4	0	470
Eider remarquable adulte ♂ *King Eider adult ♂*	5	30	193
Eider remarquable sous-adulte ♂ *King Eider subadult ♂*	6	0	10
Total eiders «mâles» *Total male eiders*		42 220	12 550
Eider femelle (brun) *Female (brown) eiders*		35 730	9 211
Total		77 950	21 761
% mâle *% male*		54,2	57,7
N^bre de mâles par femelle *No. males: 1 female*		1,18	1,36

* Sous-adulte signifie des oiseaux ne démontrant pas un plumage complètement adulte, principalement des individus de 6 à 8 mois — voir figure 2.

* *Subadult means birds not showing full adult plumage, mainly individuals 6–8 months old. See Figure 2.*

pour d'autres espèces qui partagent ces aires, comme le Canard kakawi (*Clangula hyemalis*), le Garrot commun (*Bucephala clangula*) et le Garrot de Barrow (*B. islandica*). Il devient donc impérieux d'approfondir nos connaissances sur les facteurs écologiques qui lient les eiders à ces sites afin d'être en mesure d'évaluer l'impact des activités humaines. Ce phénomène de concentration fait ressortir la possibilité d'effectuer une surveillance des populations selon des inventaires périodiques. Un tel programme d'inventaire de rappel exigerait une méthode d'estimation plus précise des effectifs. La photographie à basse altitude, elle qu'expérimentée dans la présente étude et celle de Gillespie et Learning 1974), offre une avenue intéressante. Il erait souhaitable de développer des techiques de survol (Stott et Olson, 1972) et n échantillonnage photographique adéquat fin de permettre des dénombrements récis.

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Part IV Ecology

Section IV Écologie

Somateria mollissima borealis
(photo: R.S. Palmer)

Inuit knowledge of the ecology of the Common Eider in northern Quebec

Les connaissances des Inuit sur l'écologie de l'Eider à duvet dans le Nord québécois

D.J. Nakashima

1. Abstract

Both Inuit hunters and biologists have gained some understanding of biological patterns and processes in northern ecosystems. Both groups concern themselves with the well-being of northern renewable resources. Nevertheless, their interactions have often been marred by misunderstanding and distrust. Recently both sides have taken steps to improve the relationship.

This paper describes northern Quebec Inuit knowledge of the ecology of the Common Eider (*Somateria mollissima borealis*) and attempts to demystify traditional knowledge and to awaken biologists to the value of Inuit data. Inuit hunters from communities along the Quebec coast of Hudson Strait and Ungava Bay have provided data, much of which was previously unknown to biologists, localizing major migration routes, offshore and inland nesting colonies, feeding and moulting areas, and northern wintering sites. Major overland migration routes across the Labrador Peninsula are identified and the eastern coast of Ungava Bay is designated as the moulting area of northern Labrador drakes. Inuit hunters also provided an analysis of factors influencing eider nest site selection and nesting chronology.

This paper provides a foundation to which Inuit can add more information. It provides baseline data which may be useful to plan research or may offer solutions to eider management problems. The author hopes this paper will encourage a more open exchange of ideas and knowledge between biologists and Inuit hunters. Cooperation will greatly facilitate the process of compiling much needed northern ecological baseline data and the design and implementation of an effective renewable resource management plan.

2. Résumé

Tout comme les chasseurs inuit, les biologistes commencent à comprendre les modèles et processus biologiques des écosystèmes nordiques. Les deux groupes se préoccupent du bien-être des ressources renouvelables du Nord même si leurs rapports sont souvent gâchés par l'incompréhension et la méfiance. Récemment, des mesures ont été prises d'un côté comme de l'autre pour améliorer ces rapports.

Cet article présente un aperçu des connaissances des Inuit du Nord québécois sur l'écologie de l'Eider à duvet (*Somateria mollissima borealis*), et tente de démystifier la connaissance traditionelle et d'éveiller les biologistes à la valeur des données inuit. En effet, les chasseurs inuit du Québec, vivant dans les collectivités dispersées le long du détroit d'Hudson et de la baie d'Ungava, ont fourni des données, en grande partie inconnues des biologistes, identifiant les principales routes migratoires, les colonies de nidification établies au large des côtes et à l'intérieur des terres, les aires d'alimentation et de mue ainsi que les aires d'hivernage dans le Nord. Parmi ces données, l'identification d'importantes routes migratoires survolant la péninsule du Labrador et la désignation de la côte est de la baie d'Ungava comme aire de mue des eiders mâles provenant du Labrador présentent un intérêt particulier. Les chasseurs inuit ont également fourni une analyse des facteurs qui influencent la sélection des aires de nidification de l'eider et la chronologie de la nidification de cette espèce.

Le présent travail fournit donc un noyau d'information auquel les Inuit peuvent ajouter. Il présente des données de base qui pourraient être utiles pour planifier la recherche ou résoudre les problèmes reliés à l'aménagement de l'eider. L'auteur souhaite que ce document encouragera les biologistes et les chasseurs inuit à échanger plus librement idées et connaissances. La coopération facilitera largement le processus de compilation de données de base dont nous avons grand besoin sur l'écologie nordique, et l'élaboration ainsi que la mise en application d'un plan efficace d'aménagement des ressources renouvelables.

3. ᓄᐃᑎᑕᐅᔪᖅ

ᑕᒪᕐᒥᒃ ᐃᓄᐃᓐᓄ ᐊᒻᒪᓗ ᖃᐅᔨᒪᓯᐊᕐᑏᑦ ᐆᒪᔪᓂᒃ ᑐᑭᓯᓕᐅᒥᓯᒪᒻᒪᑕ ᖃᓄᖅ ᖃᐅᔨᒪᓯᐊᒥᐊᒥᒃ ᐊᒻᒪᓗ ᐱᐅᓯᖏᓐᓂᒃ ᑯᐸᐃᒃ ᑕᕐᕋᖓᑕ ᐆᒪᔪᖏᑦᑕ ᐃᖏᕐᕋᓂᖏᓐᓂᒃ. ᑕᒪᕐᒥᒃ ᐃᓱᒫᓗᑉᐳᑦ ᐃᒻᒥᓂᒃ ᑲᒪᒋᔭᐅᑦᓯᐊᕐᖁᓗᒍ ᑯᐸᐃᒃ ᑕᕐᕋᖓᓂ ᓄᑖ ᐱᖁᑎᖃᕐᓃᑦ. ᑭᓯᐊᓂ ᐃᓄᖏᐅᑎᖃᑎᖃᕐᓯᑎᒃ ᐱᒍᒪᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐃᓱᒫᓗᓐᓂᒥ ᐃᓯᐃᓗᑕᖃᖃᑦᑕᓯᑎᒃ ᑖᒃᑯᐊ ᐃᓗᐊᓂ ᐃᒪᐃᓕᖓᔪᖃᐃᓐᓇᖃᑦᑕᒪᑦ ᑐᑭᓯᖃᑦᑕᐅᑎᖏᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐅᐸᒃᑲᑦᑕᐅᑎᖃᑦᑕᕋᑎᒃ. ᖃᒻᒥᑯᑦ ᐱᕙᓪᓕᐅᔭᐱᓃᑦ. ᑕᐃᒪᐃᒻᒪᑦ ᓄᐃᑦᓯᐳᑦ ᑕᒪᖏᑦ ᐊᕿᓕᐅᒥᒐᓯᐊᕐᒪᑕ ᖃᐅᔨᒪᖃᑎᒥᓐᓂᑯᑦ.

ᑕᒃᑲᓂ ᓯᑯᑦᓵᔭᒥ. ᓄᐃᑦᓯᔪᒥ ᑕᑯᓂᕐᒥᒃ ᑯᐸᐃᒃ ᑕᕐᕋᖓᑕ ᐃᓄᖏᑦᑕ ᖃᐅᔨᒪᓂᖏᓐᓂᒃ ᒥᑏᑦ ᒥᑦᓵᓄᑦ (ᓱᒪᑎᐅᔨᐊ ᒪᓕᓯᒪ ᐳᔭᐃᓚᔅ). ᖃᐅᔨᒪᓯᐊᕿᒪᐳᒍᑦ ᐱᐅᓯᑐᖃᕐᓂᒃ ᖃᐅᔨᒪᓂᐅᔪᒥᒃ ᖃᐅᔨᑎᓯᒍᒪᓪᓗᑕ ᖃᐅᔨᒪᓯᐊᕐᑎᓂᒃ ᐆᒪᔪᓂᒃ ᐱᐅᓯᒥᔭᐅᔪᒥᒃ ᐱᒍᓐᓇᓂᐅᑦᓯᓂ ᐃᓄᐃᑦ ᖃᐅᔨᒪᐅᓯᖓ. ᐃᓄᐃᑦ ᐅᒪᔪᕐᕋᓯᐊᕐᑎᖏᑦ ᓄᓇᓕᓂᑦ ᐱᓯᒪᔪᑦ ᑯᐸᐃᒃ ᓯᓈᓂᒥᐅᑦ ᖃᑦᓴᓯᑐᓴᕐᒥ ᐊᒻᒪᓗ ᐅᖓᕙᒥ ᓄᐃᑦᓯᓯᒪᒻᒪᑕ ᖃᐅᔨᒪᐅᓯᕐᒥᓂᒃ, ᖃᐅᔨᒪᔭᐅᓚᐅᓯᒪᖏᓚᑦᑐᒥᒃ ᖃᐅᔨᒪᓯᐊᕐᑎᓄᑦ ᐆᒪᔪᓂᒃ. ᓇᓂᓐᓂᖏᓐᓂᒃ ᐊᖅᑯᑎᓪᓚᖏᓐᓂ ᓅᑐᐊᕐᒥᒃ. ᓴᓈᒍᑦ ᓄᓇᒥᓗ ᒫᓂᑐᐅᕐᐱᖏᓐᓂ, ᓂᕆᐱᖏᓐᓂᓗ ᐊᒻᒪᓗ ᕿᓂᒍᐃᔭᕐᐱᖏᓐᓂᒃ. ᐊᒻᒪᓗ ᑕᕐᕋᒥ ᐅᑭᐅᒥ ᐃᓂᖏᓐᓂᒃ. ᐃᓱᑎᖏᑦ ᐃᓚᖏᑦᑕ ᖃᐅᔨᒪᓇᕐᑐᒥᒃ ᐱᑕᒃᑲᕐᐳᑦ ᖃᐅᔨᒪᔭᐅᔪᒍᑏᒥᒃ ᓄᓇᒥ ᐃᖏᕐᕋᓂᕐᓚᓂᖏᓐᓂ ᒪᐅᓇ ᓛᐸᑐᐊᑉ ᐃᒪᖓᑕ ᓴᓂᐊᒍᑦ ᐊᒻᒪᓗ ᓯᕿᓂᖓ ᓯᓈᖓᑕ ᐅᖓᕙᒥ ᕿᓂᒍᐃᔭᕐᐱᐅᒥᐊᖓ ᑕᕐᕋᖓᑕ ᓛᐸᑐᐊᕐᒥᐅᑉ ᐊᖑᓚᐃᕝᕕᖏᓐᓄᑦ ᒥᑏᑦ. ᐃᓄᐃᑦ ᓄᐃᑦᓯᒥᔪᑦ ᖃᐅᔨᑦᓯᕐᓯᒪᓂᒥᑎᒍᑦ ᖃᐅᔨᑎᑦᓯᔪᓂᒃ ᒥᑏᑦ ᐅᓪᓗᑦᐅᕐᐱᖏᓐᓂᒃ ᐊᒻᒪᓗ ᐅᓪᓗᑦᐅᕐᐸᓕᐊᕐᓴᐅᑕᕐᓂᖏᓐᓂᒃ.

ᓯᐳᓪᓕᐸᓪᓕᐊᓗᐊᕐᓱᓂ. ᑖᓐᓇ ᓯᑯᑦᓵᖅ ᐊᑐᓐᓇᐅᑎᑦᓯᐳᖅ ᓇᓚᑎᑦᓯᒥᐊᓪᓚᓂᕐᒥᒃ ᐃᓄᐃᑦ ᐃᓚᕐᑐᒥᐊᓪᓚᕐᓯᔭᕐᑕᖏᓐᓂᒃ ᑐᑭᓯᓇᕐᑎᓯᒥᐊᓪᓚᑐᑎᒃ. ᐱᑕᖃᕐᓯᓂ ᐱᓪᓗᕆᓐᓂᒃ ᓄᐃᑕᔪᓂᒃ ᐊᑐᕐᓂᖃᕈᓐᓇᐅᑦᓯᑎᒃ ᐊᑐᐃᓐᓇᕈᕐᑎᐊᒥᒃ ᖃᐅᔨᒪᓯᐊᕐᓂᒥᒃ ᐊᑐᐃᓐᓇᐅᑎᑦᓯᒍᓇᐅᑦᓯᑎᓪᓗ ᑐᑭᓯᓇᕐᑐᓂᒃ ᒥᑏᑦ ᐊᐅᓚᑕᐅᓂᖏᑦᑕ ᐃᓯᐃᓗᑕᖏᓐᓂᒃ. ᐱᒪᓇᐅᓂᕐᓴᖅ. ᑖᓐᓇ ᓯᑯᑦᓵᖅ ᐊᑐᕐᓂᖃᓪᓚᓇᓚᕐᒪᑦ ᖃᐅᔨᑎᓯᒪᕿᓐᓇᑐᐊᕿᓂ

ᐊᑦᓲᒦᖏᑐᓂ ᐃᓭᒪᒥᔭᐅᔦᓂᒃ ᐱᓇᓱᒍᑎᑦᓴ-ᖃᕐᑎᓯᓚᖓᓗᖅ ᐱᐸᓪᓕᐊᓂᕐᓂᒃ ᓄᐃᑎ-ᓯᐸᓪᓕᐊᓗᓂ ᐱᔭᐅᒍᒪᓪᓚᓇᑦᑐᒥᒃ ᑕᕐᕋᒥ ᐆᒪᔦᓄᑦ ᐃᓄᓐᓄᑦ ᐱᐅᓯᐅᔦᒥᒃ ᓄᐃᑎᑦᓯᒐ-ᔭᕐᑐᒥᒃ ᐊᓪᓚᓕᐊᖏᓐᓂᓗ ᑲᔦᓯᓂᖏᓐᓂᓗ ᐱᒋᐊᕐᓯᒪᔦᒥᒃ ᓄᑖᕐᒥ ᐱᓇᓱᑦᑕᐅᔦᒥᒃ ᐊᐅᓚᑕᐅᓂᒃᑯᑦ ᐊᑐᐃᓐᓇᕈᕐᑎᓂᕐᒥᒃ.

4. Introduction

The Common Eider (*Somateria mollissima*) is a resident of the coastal zone of the Inuit territory of northern Quebec. Two subspecies are recognized, *S.m. sedentaria*, which inhabits Hudson Bay, and *S.m. borealis*, which frequents Hudson Strait and Ungava Bay (Palmer 1976). The scientific literature provides limited information on the biology of the species in these regions. The Inuit of northern Quebec, however frequent the coastal zone throughout the year and, for generations, have exploited eiders for meat, eggs, and down. Consequently, they have considerable knowledge about the ecology of the Common Eider.

In 1980, the Canadian Wildlife Service (CWS) and the Makivik Corporation research department, combining the knowledge and resources of biologists and Inuit hunters, initiated a cooperative study of *S.m. borealis* in northern Quebec (Reed 1983). The study was divided into two parts. The results of the first, a joint ground survey of important nesting areas in Ungava Bay, are reported in Chapdelaine, Bourget *et al.* (this publication). For the second part, I interviewed Inuit hunters to obtain biological baseline data on the eiders of Hudson Strait and Ungava Bay. This paper reports the results of these interviews.

In this paper I attempt to illustrate the quality and depth of Inuit knowledge about northern wildlife resources, using the *borealis* subspecies of the Common Eider as an example. For a non-Inuk, obtaining a true representation of Inuit knowledge is a long and demanding process; thus the data presented in this paper represent only a beginning. Nevertheless it indicates the considerable contribution that Inuit, and subsistence hunters in general, can make towards the advancement of our understanding of northern and other ecosystems.

Scientific knowledge of northern Quebec wildlife species such as the Common Eider is incomplete. The continuing importance of wildlife resources to the subsistence economy of native peoples and the persistent pressure for development in the north make it imperative that information gaps be filled. Native hunters can be instrumental in closing these gaps and in the development and implementation of culturally appropriate, and thus effective, renewable resource management.

5. Methods

In order to collect the data for this paper, I interviewed 35 Inuit hunters from eight northern Quebec communities along Hudson Strait and Ungava Bay (Fig. 1).Using standard ethnographic techniques, a total of 70 man-hours of interview time were accumulated between April 1979 and December 1980. I interviewed hunters individually or in small groups; recorded geographic information, which dealt primarily with migration routes, feeding–flocking areas, nesting sites, and northern wintering areas on large-scale maps or air photos; and tape-recorded other types of information, such as breeding and feeding ecology and behaviour, for subsequent transcription. Most interviewing was done through a translator.

Interviewing is a logistically simple and relatively inexpensive means of obtaining information. The style of the interview is important because it affects the nature of the information obtained. I avoided a rigid style involving formalized sets of questions because it tended to draw out only short, specific answers. It proved more fruitful to open the interview with a simple request to "tell about eiders"; this prompted the hunters to take the initiative and discuss topics that they themselves considered important and which otherwise might not have been addressed. Although interviews can provide us with a certain degree of insight into the nature and content of Inuit knowledge, there is always a danger of the interviewer introducing biases or distortions through interview structure or the choice or wording of questions. As a general rule, the less the interviewer interferes, the better the results.

6. Results and discussion

In this preliminary survey of Inuit knowledge of eiders, the term "eider" refers solely to the Common Eider (*S. mollissima borealis*), with the exception of sub-section 6.6 where the term also includes the King Eider (*S. spectabilis*). The Inuit of different regions are identified by the name of the community in which they reside. Unless otherwise stated, all the information in this section was obtained from Inuit hunters, who will have an opportunity to fill in the gaps during subsequent interviews.

Figure 1
Northern Quebec Inuit communities and the present boundaries of intensive hunting activities by northern Quebec Inuit
Communautés inuit et limites du territoire présentement utilisé intensivement pour la chasse par les Inuit du Nouveau-Québec

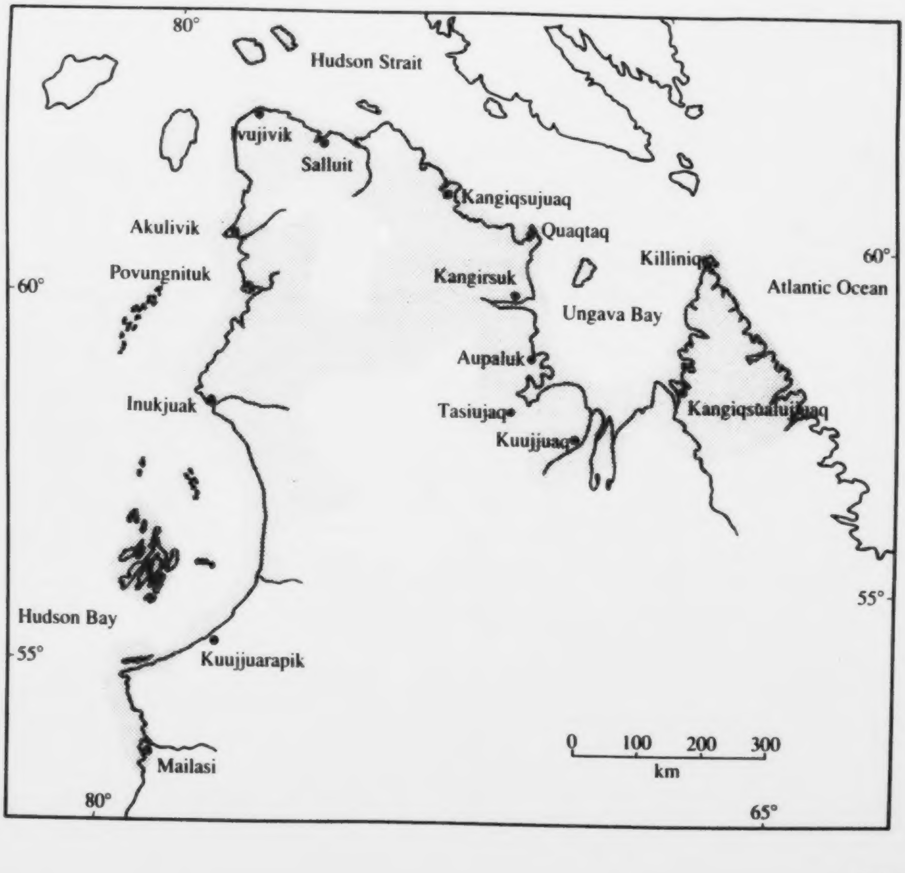
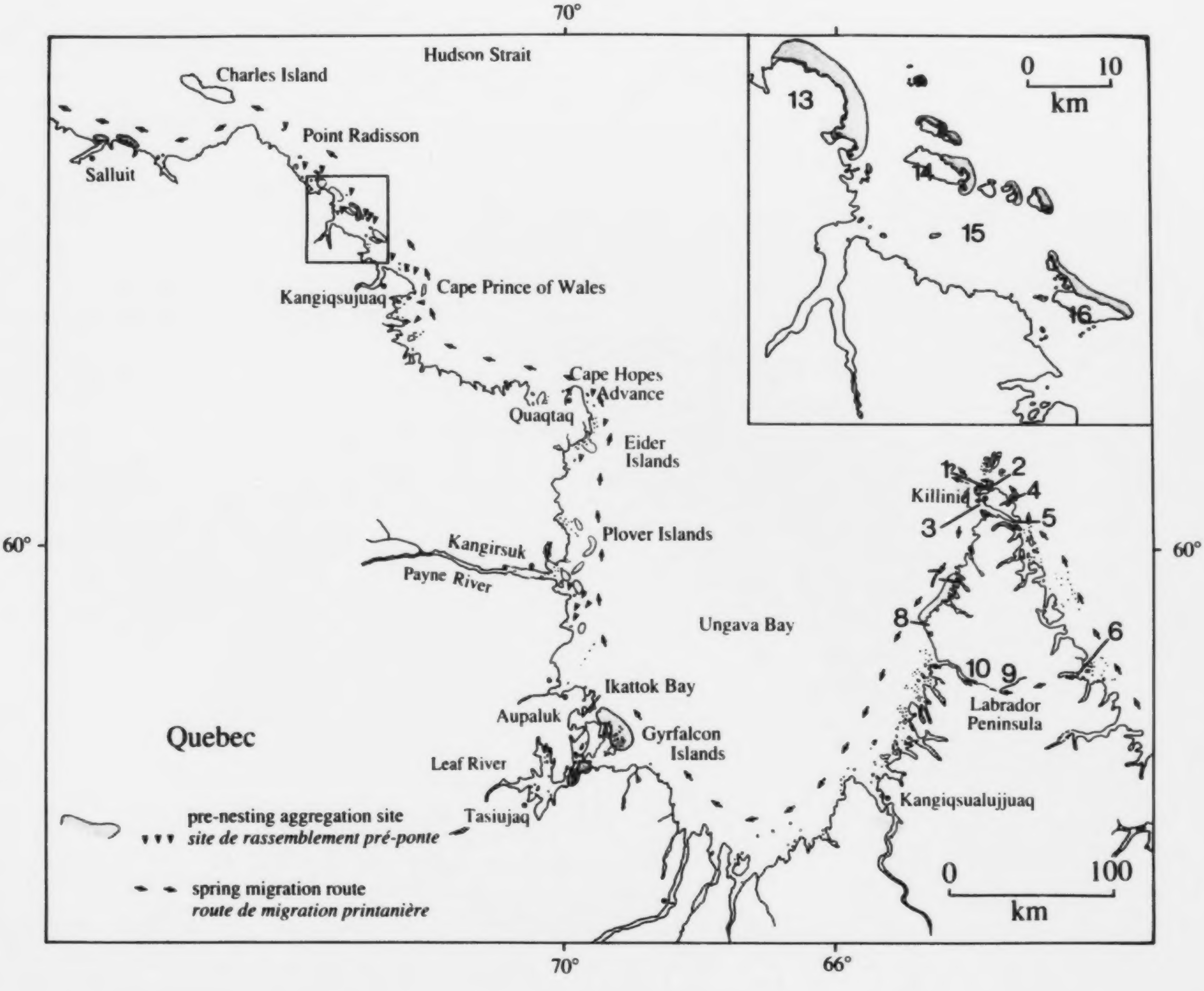


Figure 2

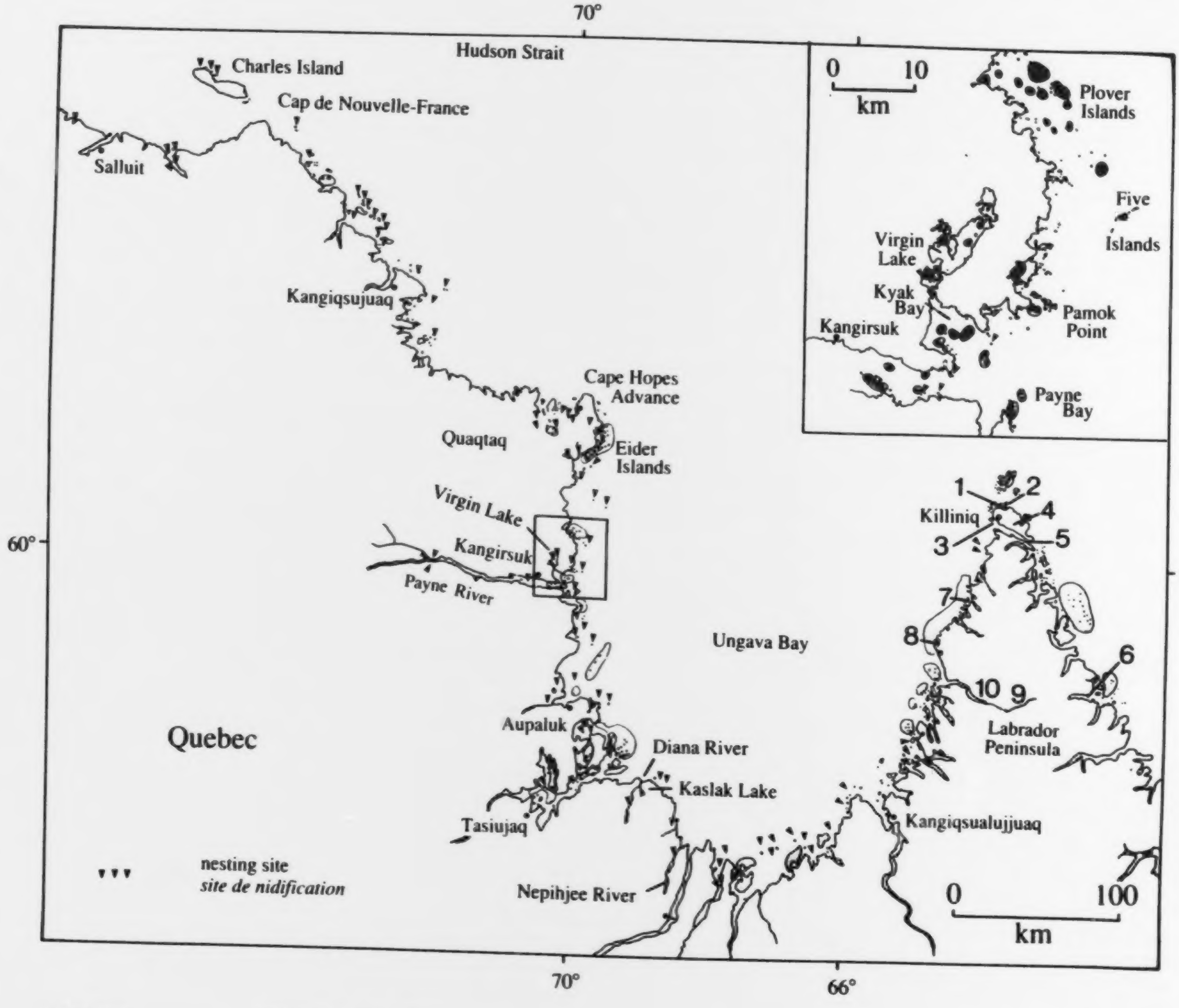
Spring migration routes and pre-nesting aggregation sites of Common Eiders along the Quebec coast of Hudson Strait and Ungava Bay and the coast of northern Labrador

Routes de migration empruntées par l'Eider à duvet au printemps et sites de rassemblement pré-ponte, le long des côtes du détroit d'Hudson et de la baie d'Ungava au Québec, et de la côte du Labrador septentrional


70°
Hudson Strait
Charles Island
Point Radisson
Salluit
Cape Prince of Wales
Kangiqsujuaq
Cape Hopes Advance
Quaqtaq
Eider Islands
Plover Islands
60°
Kangirsuk
Payne River
Ungava Bay
Ikattok Bay
Aupaluk
Gyrfalcon Islands
Quebec
Leaf River
Tasiujaq
Killiniq
1
2
3
4
5
6
7
8
9
10
Labrador Peninsula
Kangiqsualujjuaq
0
100
km
13
14
15
16
0
10
km
pre-nesting aggregation site
site de rassemblement pré-ponte
spring migration route
route de migration printanière
70°
66°
60°

1 Lenz Strait
2 Port Harvey
3 Amittok Inlet
4 Killiniq Island
5 McLelan Strait
6 Kangalaksiorvik Fiord
7 Bell Inlet
8 Pointe Le Droit
9 Rivière du Vent d'Ouest
10 Alluviaq River
11 Payne River
12 Leaf River
13 Promontoire de Martigny
14 Maiden Island
15 King George Sound
16 Wales Island

Figure 3
Common Eider nesting sites along the Quebec coast of Hudson Strait and Ungava Bay, and the coast of northern Labrador
Sites de nidification de l'Eider à duvet le long des côtes du détroit d'Hudson et de la baie d'Ungava au Québec, et de la côte du Labrador septentrional


70°
Hudson Strait
Charles Island
Cap de Nouvelle-France
Salluit
Kangiqsujuaq
Cape Hopes Advance
Quaqtaq
Eider Islands
Virgin Lake
Kangirsuk
Payne River
60°
Ungava Bay
Quebec
Aupaluk
Diana River
Kaslak Lake
Tasiujaq
Nepihjee River
Kangiqsualujjuaq
Killiniq
1
2
3
4
5
6
7
8
9
10
Labrador Peninsula
0 100 km
0 10 km
Plover Islands
Five Islands
Virgin Lake
Kyak Bay
Kangirsuk
Pamok Point
Payne Bay
▼▼▼ nesting site
site de nidification
70°
66°
60°

1 Lenz Strait
2 Port Harvey
3 Amittok Inlet
4 Killiniq Island
5 McLelan Strait
6 Kangalaksiorvik Fiord
7 Bell Inlet
8 Pointe Le Droit
9 Rivière du Vent d'Ouest
10 Alluviaq River
11 Payne River
12 Leaf River
13 Promontoire de Martigny
14 Maiden Island
15 King George Sound
16 Wales Island

6.1. Spring migration and pre-nesting aggregations □

In spring, the Common Eider migrates northwards along the Labrador coast and westwards along the coasts of Ungava Bay and Hudson Strait. This migration takes place in May although the date it peaks varies considerably from year to year.

Detailed information from the Killiniq region at the tip of the Labrador Peninsula indicates that McLelan Strait is the main thoroughfare between the Labrador coast and Ungava Bay. The movement through the strait may involve thousands of eiders daily and continues for about 2 weeks. Not all migrating eiders, however, utilize this route. A significant, but smaller proportion of the migration bypasses the east entrance of the strait and rounds the tip of the Labrador Peninsula on the north side of Killiniq Island (Fig. 2).

The consensus amongst Inuit is that migrating eiders are generally reluctant to stray far from the coast. Consequently, most claim that once the eiders have rounded the tip of the Labrador Peninsula, they fly south and follow the perimeter of Ungava Bay westwards. At least two Killiniq hunters disagree. Their observations have led them to believe that migrating eiders divide at Killiniq into flocks which take one of three different directions. One group consisting of Ungava Bay breeders follows the above route. The second flies west to Cape Hopes Advance (Quaqtaq) and the third, northwest to southern Baffin Island.

A second point of contention involves a major overland migration route that crosses the Labrador Peninsula via Kangalaksiorvik Fiord and the valleys of the Vent d'Ouest and Alluviaq Rivers. Although heavily used in the fall, Inuit hunters disagree as to whether or not eiders follow this overland route in spring.

At all stages of spring migration, flocks of migrating eiders are composed primarily of paired breeders. When they first arrive, much of the coastal area of Ungava Bay and Hudson Strait is still covered with pack and land-fast ice. In some years, extensive ice cover may interrupt the migration for a few days. On these occasions, eiders use Lenz Strait, on the northwest side of Killiniq Island, as a resting area, remaining there for one or a few days before resuming their migration. A larger gathering area lies between Bell Inlet and Pointe Le Droit, on the east side of Ungava Bay (Fig. 2). In spring, large numbers of Common Eiders and Canada Geese (*Branta canadensis*) feed in the shallow coastal waters of this area.

Eiders move to the vicinity of their future nest sites as soon as open water is available there. They congregate to feed and to await the further breakup of ice. In west Ungava Bay, pre-nesting flocks are seen amongst the Gyrfalcon Islands, south of the Eider Islands, east of the Plover Islands, and at the mouth of Ikattok Bay. On Hudson Strait, eiders are attracted to open water along the north and northeastern coasts of the islands between Cape Prince of Wales and Point Radisson (Fig. 2). In Ungava Bay, river mouths, such as those of the Leaf and Payne Rivers, are ice-free early in the season, and attract large numbers. Open water on lakes near the coast attracts Common Eiders inland. Kangirsuk Inuit have observed eiders flying inland soon after open water has appeared on lakes where eiders nest.

The Common Eiders in these pre-nesting flocks are "playful." Drakes are particularly vocal and chase and fight with other males. The most common vocalization is the cooing "aaahooo" of the males. Copulations are frequently observed at this time. Females actively feed and gain a considerable amount of weight which makes it difficult, and on occasion impossible, for them to fly.

6.2. Nest initiation, egg-laying, and incubation □

By early June, ice break-up amongst the nest islands has progressed to the point that eiders begin to select and prepare nest sites. Shortly thereafter they lay their eggs, although replacement clutches may be laid until late July. Killiniq Inuit observe that eiders nest earlier on the Labrador coast than in northern Quebec.

Most of the northern Quebec *borealis* population nests on coastal offshore islands, although some concentrations on islands in lakes or rivers are of local significance. The distribution of offshore and freshwater nesting sites relates to the availability of suitable nest islands. Large numbers of eiders nest where there are concentrations of islands. Common Eider nesting sites identified by Inuit appear in Figure 3. Of these sites, the offshore islands of the Labrador coast and colonies on freshwater lakes have the highest nest density.

The Inuit hunters know of one freshwater colony on the north Labrador coast, and 16 other sites along the west and southwest margins of Ungava Bay (Fig. 3). Although no Common Eiders nest along the Kuujjuaq River today, in 1883, Turner (*in* Bent 1962) reported a group of 14 Common Eider nests along its west bank, 28 km inland from its mouth. Distances from the seacoast of present-day inland colonies range from less than 1 km (near the Eider Islands) to 80 km (on Payne River).

At three freshwater colonies, eiders "commute" daily between inland nesting and coastal feeding areas. On the falling tide, eiders fly to the coast to feed. On the rising tide, they return to their nest colonies. This behaviour has been described for the Virgin Lake colonies near Kangirsuk, and the Diana and Nephijee River colonies, northwest of Kuujjuaq. For the latter two colonies, the observed number of commuting eiders is greater than the number at known inland nest sites. The Inuit hunters conclude that other inland colonies must occur in the area, perhaps at Kaslak Lake or Nephijee Lake.

Although nesting on the mainland is rare, it does occur, particularly where offshore islands are scarce or unsuitable. This is the case along Hudson Strait, west of Cap de Nouvelle-France, where a small number of widely scattered eider nests occur along the mainland coast.

The distribution and the dispersion of nests, and the initiation of nesting are influenced by many factors, the most important of which is predation by arctic (*Alopex lagopus*) and red foxes (*Vulpes fulva*). Eiders nest on islands to reduce predation by foxes, which are usually reluctant to swim. Large islands that can support foxes throughout the summer, and islands that can be reached by foot at low tide, provide no such haven and are generally avoided. Furthermore eiders wait until ice bridges surrounding nest islands have broken before laying their eggs. If break-up strands a fox on an island, nesting will usually not occur there, although it will resume the next year.

Human disturbance is another factor that significantly influences Common Eider nesting distribution. In spring and summer, Inuit visit colonies to collect eggs and down and to hunt adult birds. The degree of human disturbance varies between regions, but ordinarily colonies closest to a community are visited most often. Numbers of eiders are declining in areas where the hunt is intense, whereas inland and at offshore sites remote from major travel corridors, numbers are increasing.

A Kangiqsujuaq Inuk told how eiders respond to disturbance. He described an island near Whitley Bay that at one time supported a large number of breeding eiders. When Inuit began to camp regularly on this island during spring sealing, the eiders stopped nesting there. About 1960, many Inuit moved to Kangiqsujuaq, and this camp was abandoned. Today, nesting eiders are again numerous on the island.

Although the interviews brought out limited information on behavioural aspects of nesting, Kangirsuk and Quaqtaq Inuit contributed the following observations. During nest selection and construction,

Aerial view of the Gyrfalcon Islands showing ice conditions, 26 June 1980
Vue aérienne des îles Gyrfalcon montrant l'étendue des champs de glaces, 26 juin 1980
(photo: R.S. Palmer)

drakes accompany the females onto the nest island. When the first egg is laid, the nest contains little down. The female covers the egg with grass or other handy materials, and returns to the water to feed. The male may help gather nest materials. The female lays one egg per day. Constant nest attendance begins with the laying of the second or third egg. As the clutch increases in size, females sit tighter and if disturbed, return sooner. The usual clutch size is four, although up to 12 eggs are known to occur. Particularly large clutches are often attributed to two or more females laying in the same nest.

Incubating females rarely leave the nest, and then only for fresh water and a small amount of food. During these short and infrequent nest departures, the eggs are covered with down to camouflage and insulate them. Some Quaqtaq Inuit have observed drakes incubating during the early stages, but other Inuit claim that drakes never incubate. In the scientific literature, Kumlien (*in* Bent 1962) is the only author who has witnessed such an event. All other sources exclude parental care from the role of the male. McKinney (1968), who made observations on the European Eider (*S.m. mollisima*), concluded that nest-building movements by drakes were truly vestigial in this species, and that the male did not help to build the nest or incubate the eggs.

R. Dumas and I, while observing Common Eider colonies at Virgin Lake in 1982, on one occasion witnessed a drake attracted to an unattended nest containing eggs. The drake stood over the nest, rearranged the nest materials, re-positioned the eggs with its bill, and settled upon the eggs. He remained on the nest for about 7 min. Two other drakes also settled upon these eggs even more briefly. This was the only time, in over 100 man-hours of observation, that we noted this behaviour.

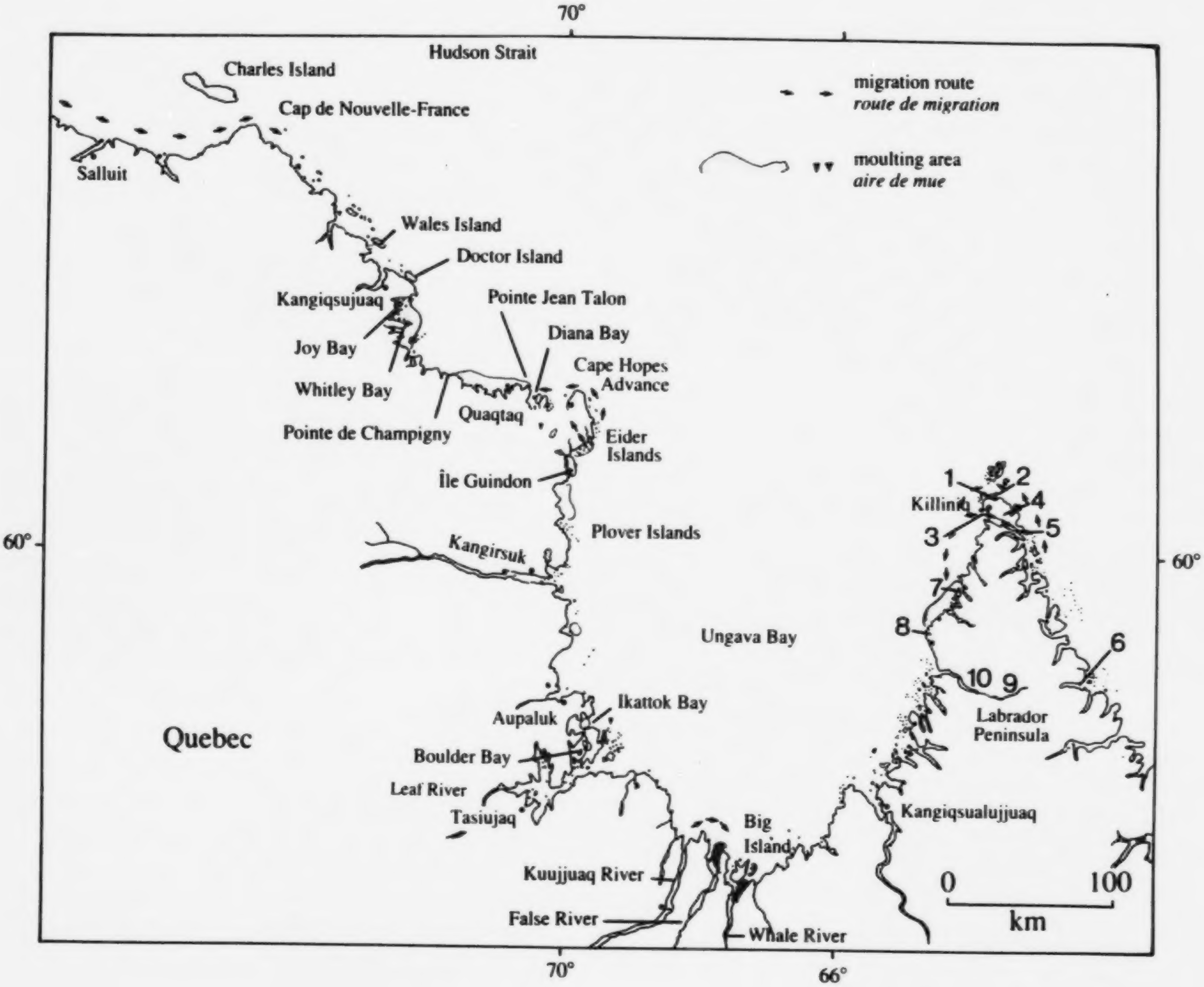
6.3. Drake post-nuptial moult migration and moulting areas

Once the clutch is complete and incubation has begun, the drakes leave their mates in order to moult. The Inuit hunters suggest that drakes experience uneasiness in the presence of ducklings and therefore leave before the eggs hatch. Drakes from breeding areas along the northern Labrador coast leave their nest sites in July, and fly northwards and westwards around the tip of the Labrador Peninsula to moult on the east shore of Ungava Bay (Fig. 4). At this time, large numbers fly westwards past Killiniq. They join an already sizable population of eiders that breeds along Ungava Bay's east shore. The numerous bays and estuaries, which extend far inland, combine with extensive shallow coastal shelves to provide shelter and food. Bell Inlet attracts a particularly large number of moulting males. By the end of July, only females and ducklings remain along the northern Labrador coast.

Another major moult migration occurs when drakes from the dense nest colonies of the Eider Islands form flocks of 20–30 individuals and fly westwards around Cape Hopes Advance in early July. Other pre-moulting drakes migrate overland from the west coast of Ungava Bay near Île Guindon to the south end of Diana Bay. These males eventually settle in an area of deep bays and elevated headlands west of Diana Bay between Pointe Jean-Talon and Pointe de Champigny (Fig. 4). Here they are usually undisturbed by hunters and form large rafts which remain near the headlands. This migration, like the one described in the previous paragraph, is directed away from the suspected wintering grounds.

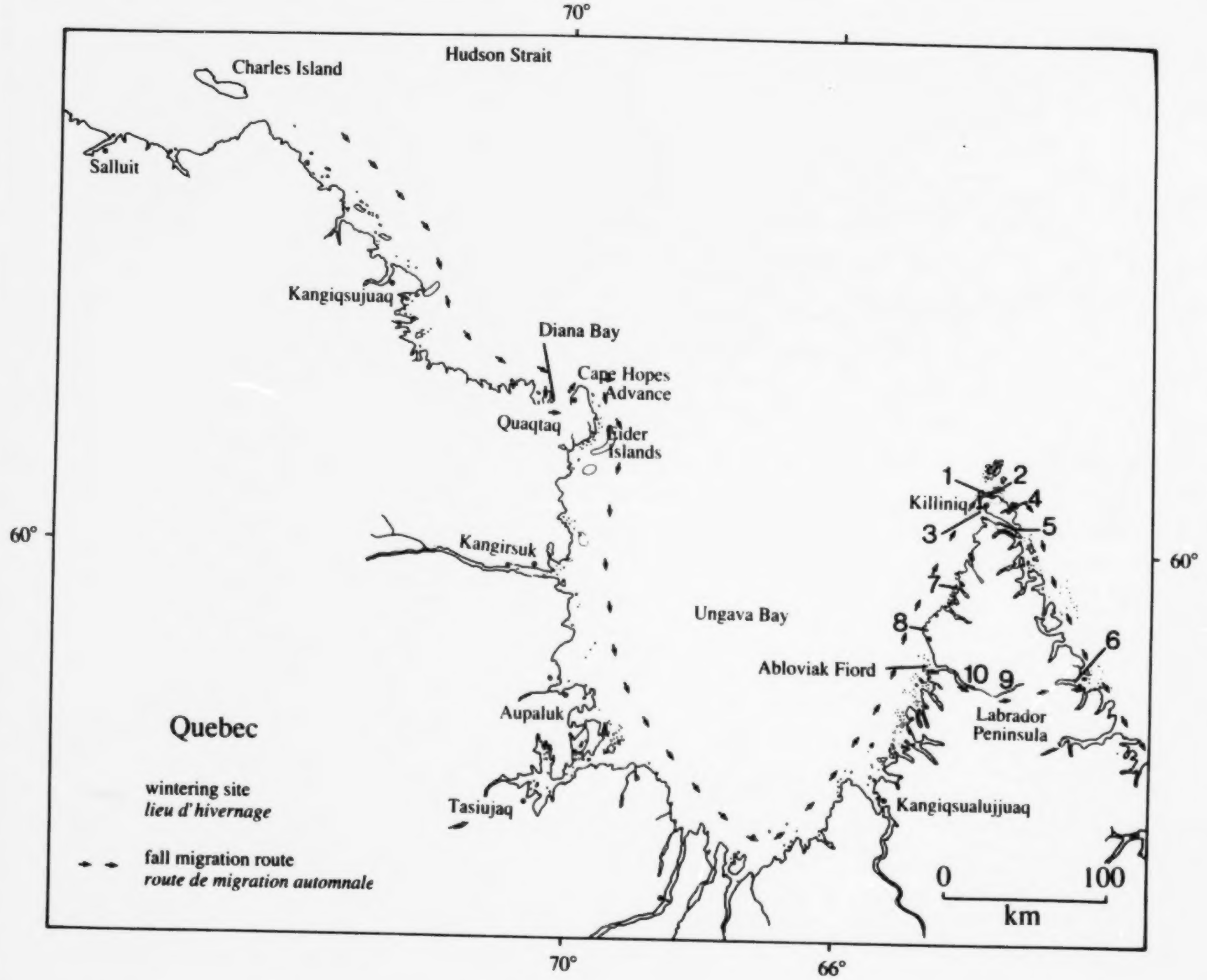
Other moult migrations are directed towards the wintering areas. Such is the case in the Salluit region, west of Cap de Nouvelle-France, where the coast offers few sheltering islands or bays. Shortly after

Figure 4
Common Eider drake moult migration routes and moulting areas along the Quebec coast of Hudson Strait and Ungava Bay and the coast of northern Labrador
Routes de migration menant aux aires de mue des Eiders à duvet mâles le long des côtes du détroit d'Hudson et de la baie d'Ungava au Québec, et de la côte du Labrador septentrional


70°
Hudson Strait
Charles Island
Cap de Nouvelle-France
migration route
route de migration
moulting area
aire de mue
Salluit
Wales Island
Doctor Island
Kangiqsujuaq
Pointe Jean Talon
Diana Bay
Joy Bay
Cape Hopes Advance
Whitley Bay
Quaqtaq
Pointe de Champigny
Eider Islands
Île Guindon
1
2
Killiniq
4
3
5
60°
Plover Islands
Kangirsuk
60°
7
8
Ungava Bay
6
10
9
Labrador Peninsula
Ikattok Bay
Aupaluk
Quebec
Boulder Bay
Leaf River
Tasiujaq
Big Island
Kangiqsualujjuaq
Kuujjuaq River
0
100
km
False River
Whale River
70°
66°

1 Lenz Strait
2 Port Harvey
3 Amittok Inlet
4 Killiniq Island
5 McLelan Strait
6 Kangalaksiorvik Fiord
7 Bell Inlet
8 Pointe Le Droit
9 Rivière du Vent d'Ouest
10 Alluviaq River
11 Payne River
12 Leaf River
13 Promontoire de Martigny
14 Maiden Island
15 King George Sound
16 Wales Island

Figure 5
Common Eider fall migration routes and wintering sites along the Quebec coast of Hudson Strait and Ungava Bay and the coast of northern Labrador
Routes de migration automnale et lieux d'hivernage des Eiders à duvet le long des côtes du détroit d'Hudson et de la baie d'Ungava au Québec, et de la côte du Labrador septentrional


70°
Hudson Strait
Charles Island
Salluit
Kangiqsujuaq
Diana Bay
Cape Hopes Advance
Quaqtaq
Eider Islands
60°
Kangirsuk
1
2
Killiniq
4
3
5
60°
7
8
Ungava Bay
6
Abloviak Fiord
10
9
Labrador Peninsula
Aupaluk
Quebec
Kangiqsualujjuaq
Tasiujaq
wintering site
lieu d'hivernage
fall migration route
route de migration automnale
0
100
km
70°
66°

1 Lenz Strait
2 Port Harvey
3 Amittok Inlet
4 Killiniq Island
5 McLelan Strait
6 Kangalaksiorvik Fiord
7 Bell Inlet
8 Pointe Le Droit
9 Rivière du Vent d'Ouest
10 Alluviaq River
11 Payne River
12 Leaf River
13 Promontoire de Martigny
14 Maiden Island
15 King George Sound
16 Wales Island

leaving their mates, drakes migrate eastwards along the coast, completely vacating the region. The location of their moulting grounds is not known. The closest known moulting areas east of Salluit are along the south coasts of Wales and Doctor Islands near Kangiqsujuaq. Eiders gather near these islands in the spring, but frequent the north coasts. In southern Ungava Bay in July, large numbers of drakes in flocks of 20–30 individuals fly east along the coast between Kuujjuaq and False Rivers. Their origin and destination are unknown. Most likely, they are bound for moulting areas in the estuaries of the False and Whale Rivers. A few thousand moulting drakes congregate east of Big Island, at the mouth of the Whale River (Fig. 4). The area is convenient for feeding as the extensive coastal shelves are covered by only a few metres of water at low tide. The drakes remain there throughout August. Driver (1958) has documented the utilization of the False River estuary by moulting drakes. On 31 August 1958, he observed about 2000 Common and King Eiders, both broods and moulting adults.

Other important moulting areas in Ungava Bay include Ikattok and Boulder Bays, north of the Leaf River, where ca. 1000 males moult. Smaller groups of males frequent the coastline north of the Plover Islands, as far as île Guindon. A major moulting area on the Hudson Strait coast occurs east of Kangiqsujuaq at Joy and Whitley Bays (Fig. 4).

6.4. Hatching and rearing of ducklings □

Common Eider ducklings hatch throughout July and early August. Usually females escort their newly hatched ducklings away from the offshore nesting islands, and towards the adjacent coast. Shallow and sheltered bays and estuaries provide the broods with food and some protection from the elements. One exception to this pattern occurs amongst the nest islands between Kangiqsujuaq and Cap de Nouvelle France. Here, the females and ducklings remain near the nest islands until the young have grown to some extent before the families move into sheltered bays along the coast. Inland nesting eiders lead their broods down streams or rivers to the sea. Broods have been observed crossing overland at night near an inland site southwest of the Eider Islands. A small river that connects this inland body of water with the sea is also used by females and their broods.

The hunters offered little information on the degree of development of crèching behaviour. The tapes indicate considerable regional variation. Along the Labrador coast, Inuit hunters have observed large crèches of ducklings independent of flocks of adult females. In the vicinity of Kuujjuaq and Quaqtaq, adult females accompanied the young, and rarely were more than two to four families seen together.

6.5. Fall migration □

By September, drakes have largely completed their moult. They are the first to depart, flying east towards the wintering grounds. During post-hatching, breeding females feed actively, in order to regain weight lost during incubation. They migrate later, when the young are able to accompany them. Some young are apparently not ready for sustained flight in time and are left behind to over-winter in northern Quebec.

An eastward migration of Common Eiders past the community of Quaqtaq and Cape Hopes Advance continues through much of October. At the beginning of the migration, no single age–sex class predominates, but towards the end, female and young-of-the-year outnumber drakes. At Killiniq, the migration continues for a longer period of time. Eiders move east past the tip of the Labrador Peninsula throughout September and October. Here drakes clearly precede the females and young, although some overlap does occur.

Migrating eiders approaching the Quaqtaq area stay close to the coast. They do not fly across the mouth of Diana Bay, nor across the base of the Cape Hopes Advance peninsula. Instead, they take the more lengthy route around the perimeter of the bay and the cape (Fig. 5). As the eiders continue past Cape Hopes Advance, their flight path shifts seaward to about a kilometre from the coast. As with the spring migration, there is no agreement on whether or not eiders fly directly from Cape Hopes Advance to Killiniq.

At least one major overland migratory route crosses the Labrador Peninsula. Common Eiders enter the Abloviak Fiord on the Quebec side, follow the valley of the Rivière du Vent d'Ouest to the divide and emerge on the Labrador coast at Kangalaksiorvik Fiord (Fig. 5). Use of this overland route reduces the migration distance by approximately 160 km (from 250 km along the coast to 90 km overland). The highest elevation along this route is less than 300 m. Kangiqsualujjuaq hunters have referred to other overland routes in this region, but the exact locations were not determined during the interviews.

Although a large number of eiders cross overland, some flocks continue to follow the much longer route around the tip of the Labrador Peninsula. One older Killiniq hunter has observed only females and young flying inland at Abloviak Fiord. He speculates that all or most drakes use the longer coastal route. Information from other Inuit suggests that no age–sex class is disproportionately represented amongst overland migrants.

Once the eiders reach the Labrador coast they move beyond the limits of Inuit knowledge. Inuit are curious and concerned about where the eiders go to spend the winter. One Inuk, an elderly and knowledgeable former Killiniq resident, said that he had heard that in the spring the eiders had to fly a long time over open water before reaching Killiniq.

6.6. Wintering sites in northern Quebec □

Although the great majority of Common Eiders (*S.m. borealis*) leave northern Quebec for the winter, some remain. In most cases, they occur as scattered individuals or groups frequenting open water along the floe edge. The only major groups of wintering eiders occur in the vicinity of Killiniq at the tip of the Labrador peninsula. Unfortunately, the Inuit word that we understood to mean King Eider, in fact refers only to the male of the species. This led to problems in distinguishing female King Eiders from brown-plumaged Common Eiders. Consequently in this section alone, the term "eider" will refer to both Common and King Eiders.

A few thousand eiders over-winter near Killiniq. These eiders occur in flocks in Lenz Strait, Port Harvey, Amittok Inlet, and the central portion of McLelan Strait (Fig. 5). Strong tidal currents around Killiniq Island keep these areas ice-free throughout winter. Most of these birds have brown plumage, and are probably hatching-year Common Eiders that were unable to migrate to the wintering grounds. During the interviews the possibility that some of these individuals might be adult female Common Eiders or adult female or young King Eiders was not explored. The remainder of this winter population is made up of adult male King Eiders.

Hatching-year eiders left behind by the fall migration are also seen near Quaqtaq in December. Furthermore, while seal hunting in March, Inuit see groups of 10–15 eiders along the floe-edge south and east of the Eider Islands (Fig. 5). The total number of eiders present at any one time is about 50. These flocks are primarily composed of brown-plumaged individuals, which could be Common or King Eider females or young. Adult male King Eiders make up the balance of the flock. The male courtship "cooing" note is heard at this time, presumably produced by the male King Eiders. When the spring migrants arrive in May, they are much fatter than the eiders that over-winter in the vicinity of the Eider Islands.

Eiders are seen along the floe-edge in other areas of northern Quebec. Numbers are always low. Aupaluk and Kangiqsujuaq Inuit report sightings of only adult male King Eiders, whereas Salluit Inuit report only Common Eiders.

6.7. Food and foraging behaviour □

Common Eiders forage in the marine littoral zone. Feeding is most intensive during low tide. Eiders feed by diving and by pulling food from the substrate. Identification of food items known to the hunters was difficult as the interviews were conducted without the aid of an illustrated invertebrate text. Consequently, the following descriptions are vague and in need of further refinement.

The most important food items are molluscs. In order of importance, Inuit hunters mentioned mussels (*Mytilus edulis*), clams (probably various species), and some gastropods. Strong regional differences in diet occur. For example, on the east side of Ungava Bay, at a major feeding area between Bell Inlet and Pointe Le Droit, the principal food of Common Eiders is clams. The ducks retrieve them by diving underwater and grasping and pulling the mollusc's protruding siphon. The clams are swallowed whole and ground up in the gizzard. On the west side of Ungava Bay, in the Quaqtaq and Kuujjuaq regions, mussels predominate in the diet of Common Eiders. The hunters believed that these regional differences in diet reflect differences in local food availability and not differences in food preference.

Other food items include amphipods and *qopirquit* (which translates roughly as "worms" and probably includes a number of small invertebrate organisms). The only marine vertebrate organisms known to be consumed are sculpins. Eiders wintering on McLelan Strait near Killiniq only feed near the shore of the steep-sided strait, and gastropods, amphipods, and *qopirquit* have been found in their crops.

Eider ducklings feed initially on amphipods, *qopirquit*, and small sculpin. Later, small mussels are incorporated into the diet. Ducklings from inland nest sites on Virgin Lake near Kangirsuk feed for a few days on sticklebacks (*Gasterosteus aculeatus, Pungitius pungitius*) before following the females down to the ocean. The female eiders do not feed while accompanying the ducklings on fresh water.

6.8. Predation and kleptoparasitism □

Inuit hunters believe that the highest mortality suffered by Common Eiders occurs during the egg and duckling stages. As discussed earlier, predation by arctic fox and red fox plays a major role in eider nesting chronology, nest island selection, and nest dispersion. Inuit have reported seeing foxes swimming to offshore islands (Labrador, Hudson Bay), but these observations are uncommon. When a fox does gain access to an island nesting colony, the results are disastrous for the eiders.

By nesting on islands, eiders can reduce predation by foxes. Water, however, poses no barrier to avian predators. Many Inuit consider gulls (*Larus* spp.) to be the most significant predators of eider eggs and young. Nests are particularly susceptible to gull predation when females flush and do not camouflage the eggs with down. Some Inuit hunters believe that an aggressive gull can drive a female from her nest. On the other hand, some Inuit maintain that eiders may benefit from nesting in association with gulls: eiders nesting within a territory defended by a gull against avian predators may have a greater chance of successfully hatching young. This same idea has been investigated by biologists (see Schamel 1977; van Dijk, this publication).

Jaegers (*Stercorarius* spp.) are considered to be more aggressive than gulls. Killiniq Inuit have seen ducks displaced from their nests by stooping jaegers. Other avian predators include the Raven (*Corvus corax*), largely an egg-eater, and the Snowy Owl (*Nyctea scandiaca*), Peregrine Falcon (*Falco peregrinus*), and Gyrfalcon (*Falco rusticolis*), which prey upon eggs, young, and adult eiders. The polar bear (*Ursus maritimus*) can be a devastating local nest predator. It can easily swim to nest islands where it may consume a large number of eggs and ducklings. The female eider is not capable of defending her eggs or ducklings from many of these predators. Unlike the larger Canada Goose which Inuit observe actively defending its nest, the Common Eider must rely upon cryptic behaviour and coloration.

Jaegers and gulls also steal food from foraging or flying adult eiders. Kleptoparasitism by gulls was described as harassment of an eider in flight, resulting in the latter disgorging food and the assailant or assailants quickly snapping it up. Foraging eiders also have food stolen from them when they surface from dives.

7. **Properties of Inuit knowledge about wildlife resources**

In the process of collecting and analysing the data presented in this paper, certain properties of Inuit knowledge became apparent. These properties, described below, although far from defining traditional knowledge, may nevertheless help us to understand its nature.

7.1. Observation and conceptualization □

Inuit knowledge can be divided into two components. Direct observations of natural phenomena constitute the first component. Thus when hunters relate where eiders nest or when the first spring migrants arrive, they are providing observational information that involves a minimum of interpretation on their part. This type of information is relatively easy to collect, forms the major part of this paper, and can be directly applied to fill gaps in our baseline data on northern wildlife.

The second component of Inuit knowledge is conceptual, comprising hunter interpretations or explanations of observed phenomena. Thus the second category would include Inuit speculation on why eiders choose to nest in some locations but reject others, or why eiders might benefit from association with territorial gulls. Conceptual information is generally more difficult to gather and represent accurately, but may ultimately provide the most intriguing and valuable insights into the workings of northern ecosystems.

7.2. Land-use patterns and the geographic extent of Inuit knowledge □

Inuit knowledge is directly linked to the use of the land. Each extended family utilizes and is intimately familiar with specific areas which have been occupied for generations (Correll 1976). When these areas of land use are linked together, they form a mosaic of contiguous overlapping territories which cover an immense region. The map in Figure 1, which illustrates the outer boundary of present-day land and water use by northern Quebec Inuit conveys the great geographic extent of their composite knowledge. It also shows the geographic limits beyond which Inuit knowledge cannot extend. Thus for a migratory species such as the Common Eider, we can reconstruct large-scale patterns of movement within the Inuit territory by piecing together information from geographically contiguous sets of hunters. However hunters have little knowledge of eiders once they have migrated beyond the outer boundary of Inuit land use.

Within the area of Inuit land use, hunter knowledge can be further qualified by two important factors. First a positive relationship exists between the extent of knowledge of an area and the intensity of its use. Land-use intensity data can thus provide guidelines by which we can roughly qualify our expectations of Inuit knowledge for a particular locality.

Secondly, land-use patterns change with the season. In summer, travel is largely by canoe and is restricted to major river systems and the sea. Present-day overland travel is limited to areas within a few days walk of communities and summer camp sites. In winter, however, snow and ice on lakes and the sea permit extensive travel both inland and seaward. Therefore, to understand the geographic extent of Inuit knowledge, we must be familiar with the pattern of seasonal land and water use.

7.3. Continuous and long-term observation □

Hunting is a year-round activity. In areas frequented throughout the year, Inuit can provide us with ecological observations that bridge all of the seasons. Further, Inuit knowledge extends not only throughout the year, but also across years and even across generations. Their knowledge is a product of long-term and continuous occupancy of the land (Brody 1976). Inuit therefore have information which permits them to assess year-to-year variation and to distinguish between short-term fluctuations and long-term trends. Inuit can provide information about past ecological events, and their knowledge allows us to put present-day data into a long-term perspective.

7.4. An ecological perspective □

Inuit consume numerous species of plants, invertebrates, and vertebrates. Gathering and hunting these organisms provide them with a great deal of ecological insight, as do their travels and life on the land. As a consequence, Inuit possess a holistic understanding of many northern ecosystems.

7.5. The dilemma of quantification □

Inuit hunters derive little benefit from absolute quantification, especially when quantities are large. However, they know whether a population has increased or decreased, or whether there are more of a species in one location than another, because these relative data are vitally important for success in the hunt and for evaluating resource potential. From the point of view of eider management, for example, this means that only biological surveys can provide statistically acceptable estimates of the breeding population of an area; yet to find out whether the local numbers of eiders are undergoing a long-term increase or decline, wildlife managers should turn to Inuit hunters.

In summary, it is important to be fully aware of the strengths and limitations of a knowledge system in order to make the most appropriate use of the information available. This discussion has touched upon a few of the more obvious properties of Inuit knowledge. Further discussions with Inuit hunters will hopefully provide greater insight into the nature of their knowledge and its applicability to current and future problems of wildlife conservation, management, and research.

8. Conclusion

Although native peoples and biologists gather information, interpret observations, and apply results quite differently, they share a common objective. This objective, in its most general form, might be defined as a desire to understand patterns and processes in the natural environment. Although both groups have made progress towards this end, neither has a complete understanding.

Biologists often lack knowledge about northern ecosystems, including those of northern Quebec. Although biologists and Inuit are both concerned about the welfare of northern wildlife resources, effective management cannot be achieved without a sound northern data base. The interests of all concerned are best served when Inuit and biologists cooperate to complete the data base and move towards joint management.

In the past, cooperation has been the exception rather than the rule. Management and research policy and practice were often imposed upon native peoples with little awareness of their knowledge and concerns. However, there are recent indications that the situation in northern Quebec is improving. The James Bay and Northern Quebec Agreement (1976) formally recognizes that government and native peoples must jointly administer and manage northern resources. With the formation of the Arguvigaq Wildlife Management Group, representing northern Quebec Inuit on renewable resource management issues, and the establishment of a biological research centre in Kuujjuaq and a cartographic centre in Kangiqsujuaq, the Inuit of northern Quebec have indicated their commitment to active participation in northern wildlife management and research. Joint research ventures, such as the 1980 CWS–Makivik eider census in Ungava Bay, are hopefully setting the foundation for cooperation between all resource users, researchers, and managers in the future.

Although this paper provides only a preliminary assessment of Inuit knowledge of the Common Eider, perhaps it will convince research biologists, resource managers, and others that Inuit hunters have a substantial contribution to make to an overall understanding of northern ecosystems, and encourage consultation and cooperation between native peoples and biologists at all levels of research and resource management.

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The numbers of nesting Northern Eiders on the West Foxe Islands, NWT, in 1956 and 1976

Nombres de Somateria mollissima borealis nichant dans la partie ouest de l'archipel Foxe (T.N.-O.) en 1956 et 1976

F.G. Cooch

1. Abstract

Studies conducted in 1956–57 and in 1976 revealed that the nesting population of *Somateria mollissima borealis* on the West Foxe Islands, Northwest Territories, Canada, declined by 67%. The change in population varied from island to island, with two groups of islands accounting for most of the decrease. The decline is attributed primarily to an increase in the shooting of adult females, and secondarily to the taking of eggs by local subsistence hunters. In terms of population balance, each adult female shot is equivalent to the taking of 8.3 nests or 29 eggs. Increased protection of breeding females, particularly on feeding areas near nesting islands, is recommended.

2. Résumé

Des études effectuées en 1956–1957 et en 1976 ont démontré que la population de *Somateria mollissima borealis* nichant dans la partie ouest de l'archipel Foxe situé dans les Territoires du Nord-Ouest au Canada, a diminué de 67 %. Toutes les îles n'ont pas senti le même changement de population : deux groupes d'îles, à elles seules, cumulent la presque totalité du déclin. La baisse de population est attribuée *primo* à une chasse plus intensive aux femelles adultes et *secundo* au ramassage des oeufs par les chasseurs de la région pour fins de subsistance. Chaque femelle adulte représente, en termes d'équilibre de la population, l'équivalent de 8,3 nids ou 29 oeufs. On propose une protection accrue des femelles adultes, principalement dans les aires de gagnage près des îles où nichent ces oiseaux.

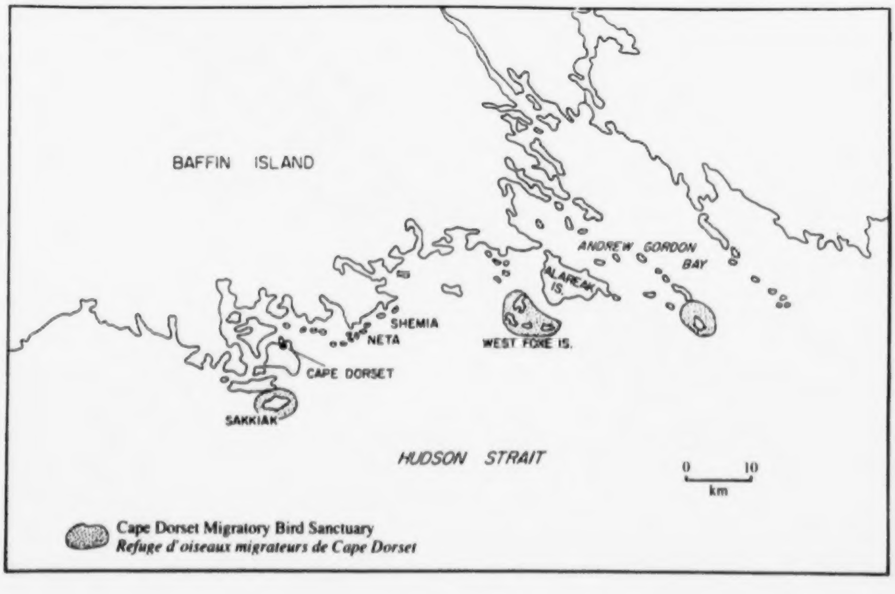
3. ᓄᐃᑎᑕᐅᔪᑦ

ᖃᐅᔨᓴᕐᓂᐅᓯᒪᔪᖅ 1956–57-ᒥ ᐊᒻᒪᓗ 1976-ᒥ ᓄᐃᑕᑎᑦᓯᐳᖅ ᑕᒪᒃᑯᐊ ᒪᓐᓂᓕᐅᕐᓂᖏᑦ ᒥᑎᑦ ᐅᐸᓂ ᕿᑭᕐᑕᒥ Foxe Island-ᒥ, ᓄᓇᑦᓯᐊᒥᑦᑐᒥ, ᑲᓇᑕᒥ, 67 ᐳᓴᓐᒥᒃ ᐃᑭᓕᒥᐊᕐᓯᒪᓂᖃᑉᐳᖅ. ᐅᓯᕆᓂᖏᑦ ᐊᒥᓱᓂᖏᑦᑕ ᒥᑎᑦ ᐊᑦᕆᒥᓕᓐᖏᓚᑦ ᕿᑭᕐᑕᒥᑦ ᕿᑭᕐᑕᓗᑦ, ᒪᕐᕈᒃ ᕿᑭᕐᑕᒃ ᐱᑦᔪᑎᒥᓗᐊᖑᐊᓯᒥᒃ ᐃᑭᓕᐸᓪᓕᐊᓂᕐᐸᓇᓴᖏᓐᓄᑦ ᒥᑎᒃ. ᐃᑭᓕᐸᓪᓕᐊᓂᖓᓗ ᐱᑦᔪᑎᖃᓗᐊᖑᐊᓯᓂ ᖁᑭᐊᓴᐅᐸᓐᓂᖏᓐᓄᑦ ᐊᕐᓇᓗᖏᑦᑕ ᐊᒻᒪᓗ ᒪᓐᓂᓴᕐᑕᐅᓂᖏᓐᓄᑦ ᓄᓇᓕᑦ ᒪᖃᐃᑦᑎᖏᓐᓄᑦ. ᑭᓯᑕᐅᒪᓂᖃᑉᐳᖅ ᐃᒪᒃ ᐊᒥᓱᓂᓇᓴᖏᑦ ᐃᑉᐱᒥᑦᓱᒥᑦ, ᐊᑕᐅᓯᖅ ᑐᖁ ᑕᐅᑉᐸᑦ ᐊᕐᓇᓗᒃ ᐃᓕᖓᓂᖃᕐᓴᕐᐳᖅ ᒪᓐᓂᓕᐅᕐᐱᖓ ᐊᓯᐅᑎᑕᐅᒻᒪᑦ 8.3 ᐅᒡᓗᓄᑦ ᐅᑉᐸᓗᓐᓂᑦ 29 ᓴᓐᓂᑦ ᐊᓯᐅᓱᖑᐳᑦ. ᓴᐳᑦᔭᐅᓂᕐᓴᐅᓂᓇᒥᐊᓕᖏᑦ ᒪᓐᓂᓕᐅᕐᑐᓄᑦ, ᒪᑯᓇᓂᓗᐊᖑᐊᖅ ᒪᓐᓂᓕᐅᕐᐱᐅᔪᓂ ᕿᑭᕐᑕᓂ. ᑕᐃᒪᐃᖁᔭᐅᓯᒪᔪᖅ ᓴᐳᒻᒥᔭᐅᓂᕐᓴᐅᖁᔭᐅᑦᓱᑎᒃ.

4. Introduction

In 1955 and 1956, I studied the breeding biology of Northern Eiders (*Somateria mollissima borealis*) in the West Foxe Islands, 40 km east of the Inuit community of Cape Dorset, NWT (Fig. 1). On 7 February 1957, with the consent of the local community leaders, the area was designated as part of the Cape Dorset Migratory Bird Sanctuary and local wardens were appointed to enforce regulations that prohibited the taking of birds and their eggs (Cooch 1965). Compliance with the restriction on the killing of adult eiders ceased after 1966 when the Inuit settled at Cape Dorset and the last of the leaders of the old hunting camps died; the egg-collecting restriction had never been enforced. I revisited the area between 8 and 22 July 1976, to re-examine the numbers and distribution of eiders as well as the effectiveness of local enforcement of Migratory Bird Sanctuary regulations.

Figure 1
Location of West Foxe Islands in relation to Cape Dorset, NWT
Situation des îles dans la partie ouest de l'archipel Foxe par rapport à Cape Dorset (T.N.-O.)



5. Study area and methods

The study area is made up of a series of islands off the southwest tip of Baffin Island (Fig. 2), which are described in Cooch (1965). The survey methods were similar to those used in 1956 (Cooch 1965) involving, wherever practical, daily nest checks. In 1976 Tunitjuak, Blades, Coatesworth, Luke, and Dune Islands were visited daily but other islands studied in 1955–56 could not be visited with that frequency because of high seas. Two of the three people engaged in the 1956 survey participated in 1976.

6. Results

The number of eider nests and the mean clutch sizes found on different groups of islands (Fig. 2) in 1956 and 1976 are presented in Table 1. Overall there were 67% fewer nests in 1976 than in 1956. Tunitjuak, Russell, and Ooglukjuak Islands showed reductions greater than 60%, Innukshuk declined by 27%, whereas Blades Island had a 14% increase.

Between the 2 years I recorded a decline from 3.44 to 3.11 eggs per nest. All islands showed a decline in clutch size, with Ooglukjuak displaying the greatest reduction and Blades the least (Tables 1 and 2). This decline may be due to some delays in nest initiation and some renesting, following limited egging on some islands.

7. Discussion

7.1. Phenology □

Nesting phenology was later in 1976 than in 1956. High winds, fog, and freezing rain characterized June 1976, with heavy snow cover persisting in some areas into July. I noted about 50 females accompanied by males in the channels between the Innukshuk Islands on 9 July 1976, a surprisingly large number of non-nesting, mated pairs for such a late date. Late phenology probably contributed to the decreased number of nests and smaller clutch sizes in 1976. I am not satisfied that in 1976 all nesting attempts or re-nesting had started by the time of our searches. By extrapolation from detailed studies on Blades, the eventual number of nests on the Innukshuk Islands for example, may have exceeded 181, whereas I recorded 153. This would mean a decrease of 14 rather than 27%. Also, in the Russell Island group and on Blades, where phenology seemed to be the only factor influencing the number of eggs per nest, clutch size dropped from 3.4 in 1956 to 3.2 in 1976.

7.2. Egg-collecting by local hunters □

Collecting eider eggs for food is a traditional activity of many Inuit communities near eider breeding areas, including

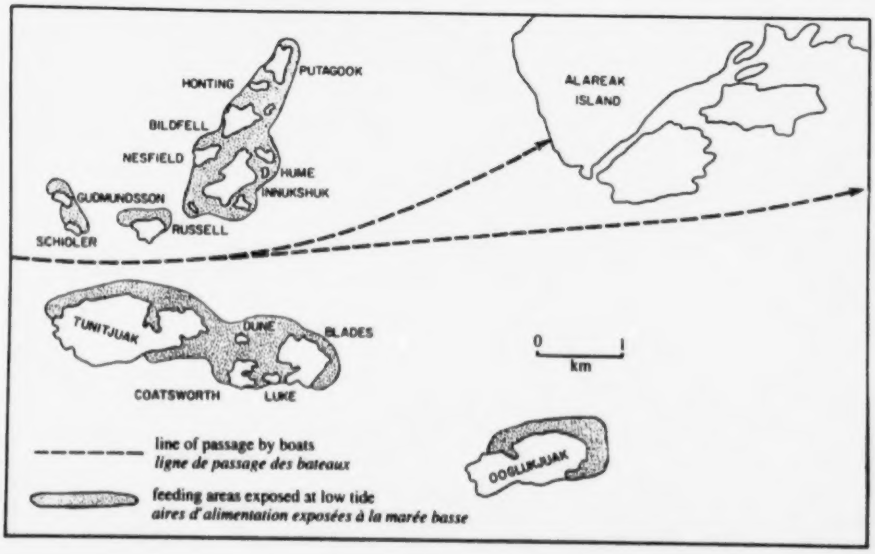
Table 1
Number of northern Eider nests and clutch sizes on the West Foxe Islands in 1956 and 1976
Nombre de nids et taille de la ponte des Somateria mollissima borealis dans la partie ouest de l'archipel Foxe en 1956 et 1976

Island group *Groupe d'îles*	Number of nests *Nombre de nids* 1956	 1976	 % change *% variation*	Mean clutch size *Taille moyenne de la ponte* 1956	 1976	 % change *% variation*
Innukshuk	210	153	−27.1	3.45	3.07	−11.0
Ooglukjuak	86	34	−60.5	3.13	2.79	−35.8
Blades	139	159	+14.4	3.42	3.22	− 4.7
Russell	108	27	−75.0	3.43	3.22	− 6.1
Tunitjuak	755	56	−92.6	3.48	3.05	−12.4
Total	1298	429	−67.0	3.44	3.11	− 9.6

Table 2
Clutch sizes of Northern Eiders on the West Foxe Islands, 1956–76
Taille de la ponte des Somateria mollissima borealis dans la partie ouest de l'archipel Foxe, de 1956 à 1976

Island group *Groupe d'îles*		Clutch size *Taille de la ponte* 1	2	3	4	5	6	7	Number of nests *Nombre de nids*	Mean *Moyenne*
Innukshuk	1956	5	37	62	80	18	6	2	210	3.45
	1976	10	28	41	51	11	2	0	153	3.07
Ooglukjuak	1956	6	15	32	29	3	1	0	86	3.13
	1976	7	10	5	7	5	0	0	34	2.79
Blades	1956	6	17	44	61	7	3	1	139	3.42
	1976	8	24	57	62	6	2	0	159	3.22
Russell	1956	4	18	32	41	11	2	1	108	3.43
	1976	3	4	8	9	2	1	0	27	3.22
Tunitjuak	1956	12	101	250	316	61	41	1	755	3.48
	1976	4	11	23	14	4	0	0	56	3.05
Total	1956	33	188	420	527	100	26	5	1298	3.44
	1976	42	77	134	143	28	5	0	429	3.11

Figure 2
West Foxe Islands showing feeding areas and line of passage
Aires d'alimentation et ligne de passage dans la partie ouest de l'archipel Foxe



Cape Dorset. In 1976 we obtained evidence that egging had occurred on Hume and Putagook Islands of the Innukshuk group, Tunitjuak Island, and Ooglukjuak Island, but had not occurred on the Russell group or on Blades Island. The three island groups subjected to egging all showed decreases in clutch size (in comparison to 1956) in excess of 10% (mean, 20%) whereas for the two others the decrease was less (mean, 5%). Thus egg removal by Inuit amplified the effects of a late season on recorded clutch sizes.

I was told that although there was some egging between 1966 and 1971 (including a reported take of 900 eggs in 1966–67) on Tunitjuak, even then the number of eiders using my former study area was not as great as it had been a decade earlier. Because eiders replace lost clutches (Cooch 1965) and usually continue to incubate those only partially taken, the impact of egging is not usually total. On the North Slope of Alaska, Schamel (1977) concluded that most early nesting eiders renest, with the proportion dropping off markedly over time. In a limited study (Cooch 1965) I found that late replacement clutches for eiders averaged 2.4 eggs per attempt.

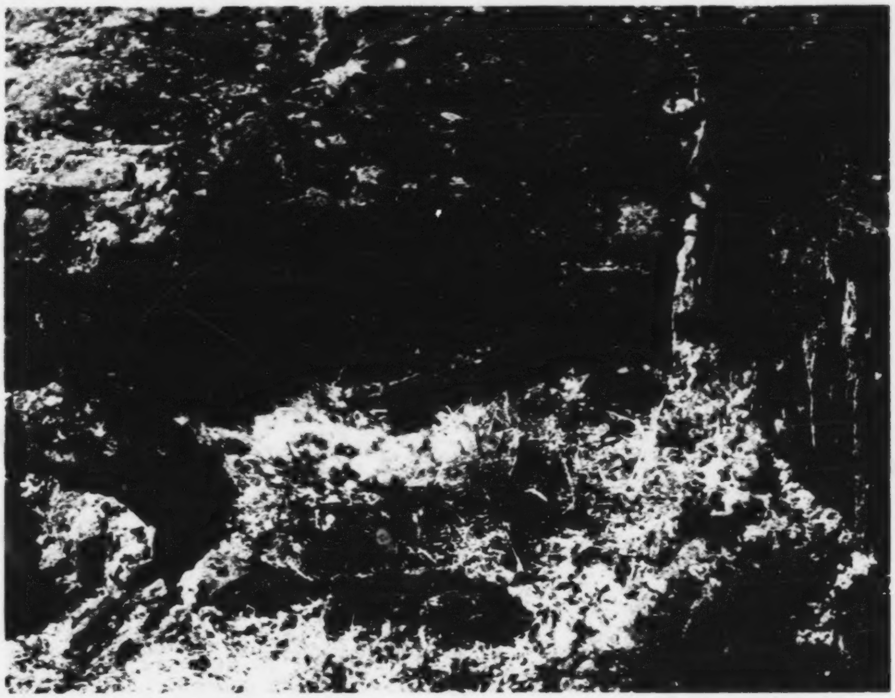
Egging by Inuit occurs mainly in the first 10 days of nesting as nowadays few enjoy the taste of eggs containing well developed embryos. On large islands with widely scattered populations hunting for eggs is not productive. A heavy toll of eggs usually only occurs when families camp on eider nesting islands (where the children demonstrate incredible efficiency in finding nests) or when islands are heavily utilized by seal-hunting parties.

Persistent egging on Ooglukjuak may have contributed to the decrease in the number of nests found there in 1976. That island is a traditional tea break site for seal hunters. On the easily accessible eastern tip of the island, 63 nests (from an island total of 86) were found in 1956 but only five in 1976. The number of nests on the rugged, less accessible western end of the island increased from 23 in 1956 to 29 in 1976.

7.3. Shooting of adult eiders –

The taking of adult eiders for food or clothing is also part of the traditional Inuit culture. Until recently that practice has probably had only a small effect on breeding populations, because of the widespread distribution of hunters and the limited means of transportation available to them. Before 1960, there were no canoes at Cape Dorset and the people were scattered along 300 miles of coast. Now, however, virtually the entire human population lives in the village and their slow-moving whaleboats have been replaced by aluminum boats and freighter canoes, powered by high-speed outboard motors. In 1956 the West Foxe Islands were visited by Inuit on four occasions in the entire summer. In 10 days in 1976 I counted at least 70 east–west passages by canoes and recorded shooting on about 20% of them. Most of the birds shot were Black Guillemots (*Cepphus grylle*), but eiders also served as targets. The activity observed did not appear to represent a deliberate hunt of adult birds but rather opportunistic "pot-shooting" while travelling for a variety of purposes. The resulting mortality of guillemots and eiders did not exist in 1956. A severe decline in the Black Guillemot colony on Russell Island over the same period was attributed to the shooting of adult birds (Cooch 1977).

In June and early July, the floe-edge follows the passage inside Blades and Tunitjuak. Once ice clears out of the West Foxe Islands, this is the line of through transit for travel along the coast. Except in very calm weather eiders utilize the inside passage of all the islands, rather than stay on the exposed seaward coasts. This is particularly true during low tide when feeding is easier, the passage is narrower and the birds concentrated. The feeding area utilized by birds on Blades Island is not on the direct line of passage whereas that used by Tunitjuak Island birds is totally exposed to traffic (Fig. 2). Because of rough ice between the islands, Tunitjuak is the effective eastern terminus of Inuit from Cape Dorset hunting seals on the sea ice. Birds waiting along the floe-edge in May and June are thus exposed to mortality not shared by those nesting on Blades or Innukshuk. I was told that as many as 80 adult females were taken from my former study area on Tunitjuak in 1966 and 1967, in addition to the eggs mentioned previously. Both the killing of adult females and the taking of eggs have been most severe on Tunitjuak, the island showing the greatest decline in numbers of nests from 1956 to 1976 (Fig. 3).



Nesting habitat, Tunitjuak Island, west Foxe Islands, NWT
Habitat de nidification, île Tunitjuak à l'ouest des îles Foxe (T.N.-O.)
(photo: G. Cooch)

7.4. Other factors –

In 1957, 1958, 1967, and 1972, severe ice conditions may have reduced reproductive output by cutting ducklings off from feeding areas along the mainland shore. Gudmundsson (1932) recorded the almost complete destruction of year classes in Iceland caused by ice.

Predation by Herring Gulls (*Larus argentatus*), Kumlien's Gull (*L. glaucoides kumlieni*), Parasitic Jaegers (*Stercorarius parasiticus*), and Common Ravens (*Corvus corax*) resulted in the loss of 25% of the eggs laid on Blades Island in 1955, 15% in 1956, and 15% in 1976. Those same species may also take ducklings. Munro and Bedard (1977) recorded a loss of 335 ducklings (13.5%) by gull predation during the movement of 2485 ducklings (*S.m. dresseri*) from natal islands in the St. Lawrence to mainland feeding areas.

During the breeding season the West Foxe Islands are free from mammalian predators such as the arctic fox (*Alopex lagopus*).

7.5. Recruitment rate and adult mortality □

Among ducks, Northern Eiders have a low annual reproductive budget. They generally do not breed until their third or fourth year, and have average clutches of fewer than four eggs. Though their reproductive potential is low, they are also long-lived and normally have low annual adult mortality. In 1955, I banded 26 nesting adult females and in 1956, retrapped 23 (Cooch 1965), giving a crude mortality rate of 12% for breeding adult females. Between 1955 and 1956, the population on Blades increased by 10%, suggesting a survival to breeding age of adult females of 12.6%, nearly double the computed long-term average. Milne and Reed (1974) and Reed (1975) estimated a survival to flight age of 8.2% of the eggs laid by Common Eider (*S.m. dresseri*) in the St. Lawrence estuary and an average annual adult mortality of 17%, which is more or less comparable to the West Foxe situation.

Figure 3
Tunitjuak Island showing numbers of nesting eiders by sector in 1956 and in 1976
Nombres d'eiders nichant sur l'île Tunitjuak, par secteur, en 1956 et 1976

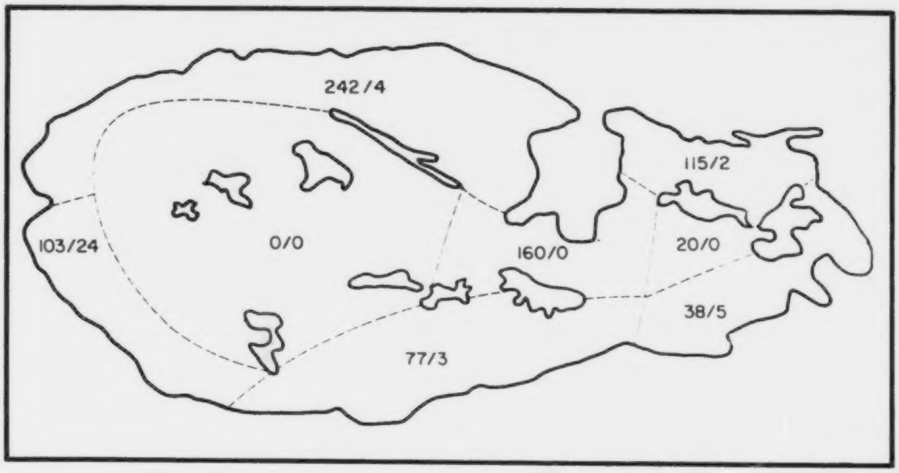


Table 3
Adult female Northern Eider recruitment in three island groups of the West Foxe Islands, 1956–76
Recrutement de femelles adultes du Somateria mollissima borealis dans trois groupes d'îles de la partie ouest de l'archipel Foxe, de 1956 à 1976

Island group *Groupe d'îles*	No. nesting pairs 1956 *N^{bre} de couples nicheurs 1956*	Change by 1976 *Variation jusqu'en 1976*	Average gain/year *Gain moyen/année*	Av. ann. replacement req. to maintain pop.* (No. ♀) *Remplacement annu. moy. nécessaire pour maintenir la popul. (N^{bre} ♀)*	Actual av. replacement/year (No. ♀) *Remplacement réel moy./année (N^{bre} ♀)*
Innukshuk	210	− 57	−1.4%	25	22
Tunitjuak	755	−699	−4.6%	91	56
Blades	139	+ 20	+0.7%	17	18

Assumed 12% mortality rate of adult females. * *En supposant un taux de mortalité de 12 % chez les femelles adultes.*

7.6. Area-specific changes: egging versus shooting of adults □

Not all islands underwent the same changes in eider populations (Table 1). For example between 1956 and 1976 Blades Island operated under a regime in which recruitment exceeded mortality by only 0.7% per annum, while Tunitjuak showed mortality in excess of recruitment by 4.6% per annum (Table 3). I attribute these area-specific variations in population change to different levels of hunting of adults and collecting of eggs on each island.

To illustrate the relative impacts of egging and shooting of adults I have developed a series of hypothetical scenarios to explain the observed rates of change on three islands: Innukshuk where egging occurred but shooting of adults was limited, Blades where both egging and shooting were limited, and Tunitjuak where egging occurred and shooting of adults was important. The assumption is made that adult female mortality and recruitment were in equilibrium at 12% in 1956. Blades is therefore considered the baseline situation with adult mortality at 12% and recruitment at 12.7%, on average from 1956 to 1976. Because the shooting of adults was also limited on Innukshuk, the decline is attributed to egging; the average annual deficit of three adult female recruits (Table 3) would have been achieved by an additional take of 87 eggs, or the equivalent of 25 nests, annually (see Table 4). On Tunitjuak the average annual deficit of 35 adult females must be attributed to the combined effects of egging and shooting. Assuming that the increase in egging on Tunitjuak occurred at the same rate as on Innukshuk only about 30% (1.4 ÷ 4.6 × 100%) or approximately 11 of the total deficit of 35 females is explained, the remaining 24 being attributable directly to shooting of adults; the 11 females lost to egging would represent about 318 eggs or the equivalent of approximately 91 nests.

The killing of nesting females cannot be quickly offset. If sex ratios at hatching are equal, 7% survival to breeding age of eggs producing females would offset a 12% average annual adult female mortality (Table 4). Each adult female killed represents the survivor from 8.3 clutches or 29 eggs.

8. Conclusions

Killing of nesting females (Cooch 1965, Salomonsen 1951, Bianki 1966), or egging, or both, has long been blamed for the collapse of local eider populations. Even after egging and other overt harassment ceases, populations do not quickly regain their former status. This may be due to the extreme site-fidelity exhibited by eiders (Cooch 1965) and an intrinsically low level of pioneering.

In years of reduced recruitment or declining populations, each additional female killed assumes increased significance in terms of population maintenance. In simple terms, 10 females shot in 1956 would represent the survivors from 9.7% of the nests, whereas in 1976, 10 females shot exceeded the replacement capability of the entire remaining population. It will be years, even decades before the populations of eiders nesting on the West Foxe Islands return to the levels of 1956.

Although the late phenology of 1976 and the bad ice years of 1957, 1958, 1967, and 1972 undoubtedly contributed to the decline recorded from 1956 to 1976, changing hunting patterns of the Cape Dorset Inuit are probably the most important factor. In the early 1960s, camp life

Table 4

Numbers of female Northern Eiders required to maintain stable populations based on numbers present during 1956 survey, assuming 12% average annual mortality

Nombres de femelles du Somateria mollissima borealis nécessaires pour maintenir les populations stables d'après les nombres d'eiders présents au cours de l'enquête de 1956, en supposant un taux de mortalité annuel moyen de 12%

Island group *Groupe d'îles*	No. ♀ in 1956 *N^{bre} ♀ en 1956*	Annual loss, assuming 12% mortality *Perte annuelle, en supposant un taux de mort. de 12%*	Total eggs laid *Oeufs pondus total*	Potential no. ♀ ducklings *N^{bre} potentiel de canetons femelles*	% survival eggs req. to replace adult losses *% de survie des oeufs nécessaires pour remplacer les pertes d'adultes*	No. nests req. to produce one recruit *N^{bre} de nids nécessaires pour produire une recrue*	No. eggs req. to produce one recruit *N^{bre} d'oeufs nécessaires pour produire une recrue*
Innukshuk	210	25	725	363	6.89	8.40	29.0
Ooglukjuak	86	10	269	134	7.46	8.60	26.9
Blades	139	17	475	237	7.17	8.20	27.9
Russell	108	13	370	185	7.03	8.30	28.5
Tunitjuak	755	91	2627	1314	6.93	8.30	28.9
Total	1298	156	4466	2233	6.99	8.30	28.6

ceased and 600 people were concentrated at the settlement. The hunter population using the area increased from 10 to 200. Mobility was enhanced when snowmobiles and canoes replaced dogs and whale boats, contributing to increased pressure on all wildlife resources within 80 km of Cape Dorset. Because Tunitjuak is the effective eastern terminus of seal hunters from Cape Dorset, its breeding females are exposed to heavier shooting than those of Blades or Innukshuk. In 1966 and 1967 heavy egging and shooting of adults took place on and near Tunitjuak, and limited egging continued there until 1971, when it became unprofitable. Termination of this activity was followed by the bad ice year of 1972.

These cultural and technological changes have favoured a somewhat greater kill of adult females, upsetting a balance which could have been maintained by an increased, but controlled, harvest of eggs.

Adult females in spring require increased protection, particularly on feeding areas near nesting islands. To accelerate the re-establishment of populations at or near their mid-1950s level, egg-collecting should be reduced and limited to the laying period when renesting is most likely to occur.

9. Acknowledgements

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11. Postscript

I revisited the West Foxe Islands between 31 July and 8 August 1981 and on 30 June 1983 overflew the islands (Gaston and Cooch, this publication). In 1981, I arrived just after the first broods had hatched and was greeted at Blades Island by large flocks of flying adult female eiders. The sanctuary sign had been demolished and signs of extensive egging were everywhere. I found a total of 189 active and recently active nests, but estimated production of young was only 38 ducklings or 8% of the 1976 estimate. The same situation prevailed on Innukshuk where estimated production was 35 ducklings or 7.6% of what had been observed in 1976. Total production on the four islands visited (all from renesting) was estimated to be 244 compared with 1185 in the same areas in 1976 and 3878 in 1956.

During a coastal survey in 1983, a major decrease in eider populations was revealed as soon as we had passed by Andrew Gordon Bay (Gaston and Cooch, this publication). Only 100 birds were seen at the West Foxe Islands. In 1984, the area west of Cape Dorset was surveyed. No eider concentrations were seen within 150 km of the settlement and a complete coverage of Sakkiak Island (which forms part of the Cape Dorset Migratory Bird Sanctuary) failed to yield a single bird, whereas in 1955 this island had supported nearly 1100 nests.

In conclusion, no significant population of Northern Eiders now exists along 300 km of Foxe Peninsula coast centred by Cape Dorset.

The breeding biology of eiders at Ile aux Pommes, Quebec

La biologie de la reproduction des eiders sur l'île aux Pommes (Québec)

B. van Dijk

1. Abstract

Factors influencing breeding success in the Common Eider (*Somateria mollissima dresseri*) in a colony of Herring Gulls (*Larus argentatus*) and Great Black-Backed Gulls (*L. marinus*) were studied at Ile aux Pommes, Quebec, in 1977. Of 520 clutches, 22.3% hatched at least one young, 63.3% were plundered by gulls, and 14.4% abandoned. Success was highest early in the season and declined rapidly thereafter. The average size of completed clutches was 3.90 ± 0.09 (SE) eggs (n = 221). Clutches initiated before 24 May were significantly larger than later clutches. Abandoned clutches were significantly smaller than those that hatched or were completely destroyed by predators; they also suffered significantly more partial predation before being abandoned. Hatching success of eiders was negatively correlated to eider nest density, but positively correlated to Herring Gull nest density. Generally, successful nests were closer to Herring Gull nests than were unsuccessful ones. Hatching rate was highest in *Calamagrostis canadensis* and shrubs, and lowest in *Epilobium angustifolium* and on bare rocks. Overhead cover did not influence the rate of nest predation. Cover, including both overhead and lateral components, was significantly less at nests that were abandoned than at those that hatched or were completely lost to predation. Generally, those sides of the nest most exposed to windchill were better protected by cover, which suggests that eiders selected locations that offered protection from windchill.

2. Résumé

Des facteurs pouvant influencer le succès de la nidification de l'Eider à duvet (*Somateria mollissima dresseri*) ont été étudiés en 1977 sur l'île aux Pommes (Québec) où nichaient, également, un grand nombre de Goélands argentés (*Larus argentatus*) et de Goélands à manteau noir (*L. marinus*). Sur 520 nids, 22,3 % ont produit au moins un jeune, 63,3 % ont été détruits par des goélands et 14,4 % ont été abandonnés. Le taux du succès de la nidification était supérieur au début de la saison, mais diminuait rapidement par la suite. La taille moyenne de la ponte était de 3,90 ± 0,09 (erreur type) oeufs par nid (n = 221). Les pontes initiées avant le 24 mai étaient de taille supérieure à celles commencées plus tard. Des nids abandonnés contenaient moins d'oeufs que des nids qui ont produit des jeunes ou qui ont été totalement détruits par des prédateurs; ils ont aussi souffert davantage de la prédation partielle avant d'être abandonnés. Il y avait une corrélation négative entre le taux du succès de la nidification des eiders et la densité de leurs propres nids, mais ce même taux était en corrélation positive avec la densité de nids de Goéland argenté. Généralement, les nids d'eider qui ont produit des jeunes se trouvaient à une plus grande proximité des nids de Goéland argenté que ceux qui n'en ont pas produit. Le taux de succès était supérieur pour les nids situés dans des *Calamagrostis canadensis* et des arbustes que ceux situés dans des *Epilobium angustifolium* ou sur la roche nue. L'abri offert par la couverture végétale directement au-dessus du nid n'influençait pas le taux de prédation des nids. Cette couverture, tant au-dessus que sur les côtés du nid, était significativement moins dense aux nids abandonnés qu'aux nids qui se sont rendus à terme ou qui ont été détruits par des prédateurs. Généralement, les côtés des nids les plus exposés aux vents refroidissants étaient bien protégés par la végétation, ce qui suppose que les eiders recherchent des sites ainsi protégés afin de minimiser les pertes énergétiques.

3. Introduction

Large breeding colonies of Common Eiders (*Somateria mollissima dresseri*) are found on islands in the St. Lawrence estuary (Reed 1973; Milne and Reed 1974; Chapdelaine, Dupuis *et al.*, this publication). Island breeding of waterfowl probably reduces mammalian predation on eggs and adult birds (Hildén 1965). Although most eiders in the estuary breed on forested islands, about one-fourth of the overall breeding population nests on islands with grasses and shrubs; these latter islands are shared with Herring Gulls (*Larus argentatus*) and Great Black-backed Gulls (*L. marinus*). Milne and Reed (1974) report lower hatching success of eiders in mixed colonies than of those on wooded islands. They attribute the difference to differences in density of breeding gulls and to the degree of concealment of nests from avian predators. The present study examines, in greater detail, factors influencing breeding success of eiders in a colony shared with gulls on Ile aux Pommes, a grassy island in the St. Lawrence estuary.

4. The study area

Ile aux Pommes (69°16′ N 48°06′ W: see also Figs. 1 and 2 in Chapdelaine, Dupuis *et al.*, this publication), is approximately 5 km from the south shore of the St. Lawrence, and is composed of Paleozoic schists partially covered with soil (Fig. 1). Its length is 1.7 km and its maximal width 200 m. The island is surrounded by five islets and the mean tidal amplitude is 3 m.

There are two types of vegetation on the island.

a) On protected parts *Calamagrostis canadensis* dominates with *Epilobium angustifolium*, *Ribes hirtellum*, *Rubus idaeus*, *Rosa blanda*, and some *Heracleum maximum* also present. Some gnarled individuals of *Picea glauca*, *Betula papyrifera*, and *Alnus crispa* are the only trees present.

b) The more exposed parts of the island are covered with *Elymus arenaria*, along with *Lathyrus japonicus*, *Rumex mexicanus*, and some *Epilobium angustifolium* and *Rubus idaeus*.

Approximately 1400 eider, 2830 Herring Gull, 470 Great Black-backed Gull and 355 Double-crested Cormorant (*Phalacrocorax auritus*) nests were present on the island when this study was done in 1977 (Chapdelaine, Dupuis *et al.*, this publication).

5. Methods

I selected four study areas, representing what I judged to be different vegetation types and densities of gull and eider nests (Fig. 1). I visited the nests at least once every week, except during adverse weather, and determined dates of nest initiation by back-dating, assuming a laying rate of one egg per day and an incubation period of 26 days (Milne 1974; Cooch 1965; Guignon 1967, 1968; this study). For 109 eider nests I photographed nest cover, following the method of Burger (1972), using a Mamiya 500 mx 35 mm camera equipped with standard 50 mm lens and Maxwider 49 mm super wide-angle auxiliary lens. The camera was placed in the nest with the lens pointing upwards and was released with a 1.5 m remote trigger. A grid of concentric circles and radii, forming 160 sectors, was superimposed on the photographs and the percentage of sectors containing cover was determined. Overhead cover was represented by the sectors contained within the two central circles, and lateral cover by the outer three. Photographs were taken when most clutches had been incubated for about 1 week, although a few early nests were 2–3 weeks into incubation. This did not influence the data because vegetation did not develop earlier. I collected data on distances between eider nests and the nearest gull nest when the nesting season was over.

6. The breeding cycle of eiders and gulls

During my first visit to the island (28 April) I observed some eiders but no nests. Many gulls were on breeding territories then and several nests contained eggs, mostly Great Black-backed Gull eggs which appeared 1–1.5 weeks earlier than Herring Gull eggs. From 28 April through the 3rd week in May I observed eiders search for and prepare nest sites. Conflicts with other eiders and gulls were frequent.

Eiders began to lay about 24 April and by 10 May 17% of eider nests (n = 520, Fig. 2) contained eggs. Nest initiation peaked during 21–27 May when 28% of the clutches were started. By 11–17 June nearly all clutches had been initiated, although the latest was begun on 7 July. Hatchings first occurred during 21–27 May and peaked during 11–17 June.

The peak in gull nest initiation occurred during 7–13 May; by 13 May 76% of gull nests (n = 522) contained eggs and by 23 May, 99%. Thus, the laying and incubation schedule of the gulls was about 2 weeks earlier than that of eiders.

Observation from a hide showed no hostility of gulls towards incubating eiders and a high degree of nest attendance by the latter.

7. Clutch size and success

Using only completed clutches (i.e., those in which the largest number of eggs recorded was also present on at least two subsequent visits), the mean clutch size was 3.90 ± 0.09 (SE) eggs (Table 1), a value greater than that for all nests found (3.63 ± 0.07, $n = 487$, $p<0.025$). Clutches for which the laying pattern suggested that they were produced by more than one female were omitted from that analysis. Early clutches (initiated before 24 May) were larger (mean, 4.07 ± 0.11, $n = 148$) than those initiated afterwards (3.53 ± 0.13, $n = 73$, $p<0.05$).

Nest losses were a result of predation or abandonment. Gulls were responsible for most, if not all, predation. As a result of these losses only 22.3% of 520 nests produced one or more young and only 25.5% of 1823 eggs hatched; that difference in success rates is due to the larger clutches found in successful nests (Table 1). Abandoned nests were characterized by smaller clutches. Success of clutches dropped from an initial value of 50% to about 10% by 21 May; loss due to predation increased from less than 45% to about 70% during this time. Abandonment rose from less than 8% to about 19% after 21 May (Fig. 3).

Nest records revealed that 17% of all nests were robbed of one or more eggs while still active. (Table 2 shows the frequency of partial predation which occurred on nests that eventually hatched or were unsuccessful.) This partial predation caused a loss of 147 (8.1%) eggs and was particularly common in clutches that were subsequently abandoned.

8. Nest success in relation to location and nest density

Eider hatching success was negatively correlated to nest density of conspecifics, but positively correlated to Herring Gull nest density (Table 3). Predation rates were high, especially in area 4 where eiders nested close together. This was the only area in which nests were significantly clustered ($p<0.001$; see Clark and Evans 1954) as a result of a spatial concentration of shrubs, a cover type strongly preferred by eiders. Nest density of Herring Gulls was highest in areas 1 and 2 where eider hatching success was greatest, and lowest in area 4. Nesting close to Herring Gulls may be advantageous (Table 4). Generally, successful nests were closer to those of Herring Gulls than unsuccessful ones, but the difference was significant only in area 3 ($p = 0.01$).

Figure 1
Map of Ile aux Pommes showing the limit of vegetative cover and the location of intensive study areas
Carte de l'île aux Pommes démontrant la limite de la couverture végétale et l'emplacement des secteurs d'études intensives

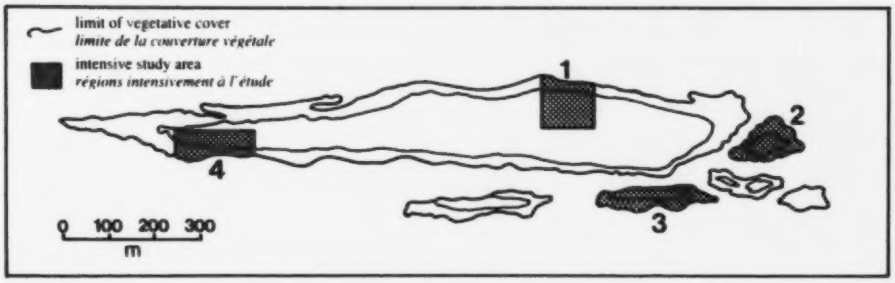

limit of vegetative cover
limite de la couverture végétale
intensive study area
régions intensivement à l'étude
1
2
3
4
0
100
200
300
m

Table 1
Mean clutch size of completed Common Eider clutches in relation to outcome, Ile aux Pommes, 1977
Taille moyenne de la ponte dans les nichées complètes d'Eider à duvet, en rapport au sort des nids, île aux Pommes, 1977

Fate of nest *Sort des nids*	Mean clutch ± SE *Ponte moyenne ± erreur type*	Number of nests *Nombre de nids*		
Hatched *Éclos*	4.20 ± 0.11	76		
			$p > 0.05$	
Lost by predation *Détruits par des prédateurs*	3.97 ± 0.15	102		$p < 0.01$*
			$p < 0.01$	
Abandoned *Abandonnés*	3.19 ± 0.18	43		
Total	3.90 ± 0.09	221		

* This probability value relates to a comparison between hatched and abandoned nests.

* *Cette valeur de probabilité se réfère à une comparaison entre les nids qui ont éclos et ceux qui ont été abandonnés.*

Figure 2

Common Eider nest initiation by weekly intervals, Ile aux Pommes, 1977

Début de la ponte chez l'Eider à duvet, par intervalles d'une semaine, île aux Pommes, 1977

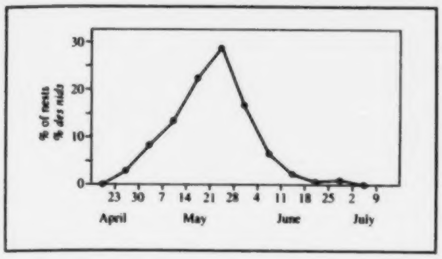
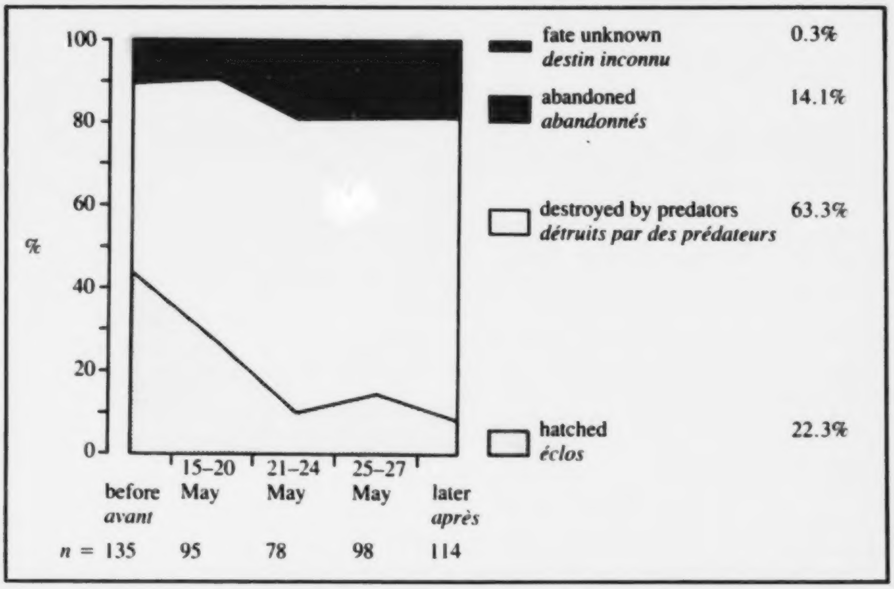


Figure 3

Fate of Common Eider nests in relation to dates of nest initiation, Ile aux Pommes, 1977

Sort des nids d'Eider à duvet par rapport à la date du début de la ponte, île aux Pommes, 1977



Common Eiders, a Great Black-backed Gull, and a Herring Gull on the shore of Ile aux Pommes

Des Eiders à duvet, un Goéland à manteau noir et un Goéland argenté sur la rive de l'île aux Pommes

(photo: A. Reed)

A detailed evaluation of the influence of nest density of Great Black-backed Gulls and their proximity to eider nests (Tables 3 and 4) on eider nest success is not possible because of low densities and small sample sizes. In a sector of area 4 Great Black-backed Gulls were, with few exceptions, the sole gull occupants; in that sector eiders began nesting later than elsewhere in the area, attained lower nest density and achieved lower hatching success (8.1%, $n = 62$ vs 16%, $n = 250$).

Differences in overall distances to gull nests between successful and unsuccessful nests were not significant, but eiders nested significantly closer to gulls in areas 1 and 2 than in areas 3 and 4 ($p<0.05$).

Causes of nest loss differed between areas. In the most successful area (1) only 25.9% of the clutches were lost to predators and 32.8% were abandoned, whereas in area 4, 73.6% were lost to predators and only 7.4% abandoned. Those different abandonment rates may be biased: the rate in area 1 might have been abnormally high as a result of disturbance from the nearby cabin, and the rate in area 4 may have been higher because some nests recorded as destroyed could have been previously abandoned.

Finally, hatching success may have been influenced by the date of onset of nest initiation. Nest initiation was on the average 6 days later in area 4 and hatching success considerably lower in comparison with area 1.

9. The nest site

9.1. Cover types □

Table 5 shows the cover types in which eiders nested and the nest success achieved therein. Cover, before 24 May, consisted of dead grass, branches of shrubs, and rocks. Grasses and *Epilobium* soon developed a dense foliage; shrubs did so only after the nesting season was over. Only 7.1% of the Common Eider nests were initiated on denuded locations. This suggests that the degree of foliage development in the various cover types was not important in the choice of a nest site. Highest success was found in those vegetation types where most eiders nested (grasses and shrubs). Success in other cover types was less than 10%.

Herring Gulls and eiders used the more protected parts of the island with *Calamagrostis* and shrubs, whereas Great Black-backed Gulls tended to nest on more exposed sites characterized by *Elymus* and bare rocks.

Table 2

Frequency of partial predation on successful and unsuccessful Common Eider clutches, Ile aux Pommes, 1977

Fréquence de la prédation partielle sur des nids d'Eider à duvet qui ont produit des jeunes ou non, île aux Pommes, 1977

Final outcome of eider clutches *Sort des nids d'eider*	% suffering partial predation *% des nids ayant souffert de prédation partielle*		
Clutch completely destroyed by predation ($n = 327$) *Ponte totalement détruite par des prédateurs ($n = 327$)*	14.7	$p > 0.05$	$p < 0.01$*
At least one young hatched ($n = 116$) *Au moins un jeune d'éclos ($n = 116$)*	14.8	$p < 0.01$	
Clutch abandoned ($n = 73$) *Ponte abandonnée ($n = 73$)*	31.5		

* This probability value relates to a comparison between destroyed and abandoned nests.

* *Cette valeur de probabilité se réfère à une comparaison entre les nids détruits par les prédateurs et ceux qui ont été abandonnés.*

Table 3

Fate of Common Eider clutches in relation to location, Ile aux Pommes, 1977. Mean date of nest initiation and nest densities of eiders and gulls are also indicated

Sort des nids d'Eider à duvet par rapport à l'emplacement, île aux Pommes, 1977. Les dates moyennes de la ponte du premier oeuf ainsi que la densité des nids d'eider et de goéland sont indiquées

	Area 1 *Secteur 1*	Area 2 *Secteur 2*	Area 3 *Secteur 3*	Area 4 *Secteur 4*
Fate of eider clutches, % *Sort des nids d'eider, %*				
Hatched *Éclos*	39.7	34.1	29 4	14.7
Destroyed by predators *Détruits par des prédateurs*	25.9	41.5	52.9	73.3
Abandoned *Abandonnés*	32.8	24.4	16.2	7.4
Unknown *Inconnu*	1.6	0	1.5	4.8
No. of nests *N^{bre} de nids*	58	82	68	312
Mean date of initiation (eider) *Date moyenne du début de la ponte (eider)*	17 May	20 May	20 May	23 May
Number of nests per 100 m^2 *N^{bre} de nids par 100 m^2*				
Eider *Eider*	0.5	1.1	0.9	3.0
Herring Gull *Goéland argenté*	2.5	2.7	1.8	1.3
Great Black-backed Gull *Goéland à manteau noir*	0.2	0.7	0.2	0.9

Table 4
Fate of eider nests in relation to the distance to the nearest gull nest, Ile aux Pommes, 1977
Sort des nids d'eider par rapport à la distance la plus proche d'un nid de goéland, île aux Pommes, 1977

		Distance in metres to nearest gull nest (sample size) *Distance (en mètres) du plus proche nid de goéland (taille de l'échantillon)*			
Species *Espèce*	Fate of eider clutches *Sort des nids d'eider*	Area 1 *Secteur 1*	Area 2 *Secteur 2*	Area 3 *Secteur 3*	Area 4 *Secteur 4*
Herring or Great Black-backed Gulls *Goéland argenté ou Goéland à manteau noir*	Hatched *Éclos*	2.33 ± 0.20(23)	2.02 ± 0.14(28)	3.34 ± 0.33(21)	3.17 ± 0.28(44)
	Destroyed or abandoned *Détruits ou abandonnés*	2.67 ± 0.20(29)	2.24 ± 0.20(51)	3.17 ± 0.29(41)	3.07 ± 0.12(243)
	All nests *Tous les nids*	2.50 ± 0.14(52)	2.16 ± 0.14(79)	3.24 ± 0.22(62)	3.09 ± 0.11(287)
Herring Gull *Goéland argenté*	Hatched *Éclos*	2.42 ± 0.32(12)	1.87 ± 0.28(7)	2.19 ± 0.29(5)	2.38 ± 0.45(10)
	Destroyed or abandoned *Détruits ou abandonnés*	3.02 ± 0.47(10)	1.83 ± 0.44(5)	5.22 ± 0.77(11)	2.63 ± 0.23(48)
	All nests *Tous les nids*	2.69 ± 0.28(22)	1.85 ± 0.23(12)	4.50 ± 0.44(16)	2.59 ± 0.20(58)
Great Black-backed Gull *Goéland à manteau noir*	Hatched *Éclos*	4.10 ± 0.00(1)	2.65 ± 0.68(3)	3.07 ± 0.46(6)	3.92 ± 0.42(11)
	Destroyed or abandoned *Détruits ou abandonnés*	3.68 ± 1.58(2)	3.33 ± 0.99(5)	3.64 ± 0.46(7)	3.68 ± 0.86(51)
	All nests *Tous les nids*	3.80 ± 0.91(3)	3.08 ± 0.69(8)	3.37 ± 0.33(13)	3.72 ± 0.23(62)

Table 5
Hatching success and average initiation dates of Common Eider nests in relation to cover types, Ile aux Pommes, 1977. Types of cover selected by gulls are also indicated
Succès de l'éclosion et dates moyennes de la ponte chez l'Eider à duvet par rapport au type de couverture abritant le nid, île aux Pommes, 1977. Les types de couverture choisis par les goélands sont également indiqués

	% eider nests that hatched *% de nids d'eider qui ont éclos*	Average date of eider nest initiation (May) *Date moyenne du début de la ponte chez l'eider (mai)*	% of nests established *% des nids établis*		
			Common Eider *Eider à duvet*	Herring Gull *Goéland argenté*	G.Bl.-b Gull *Goéland à manteau noir*
Shrubs *Arbustes*	23.6	20	40.0	26.6	5.3
Calamagrostis	28.6	21	37.5	54.7	31.5
Dead matter or rocks *Matière morte ou roches*	8.1	22	7.1	7.8	18.5
Elymus	18.4	21	6.2	10.9	44.7
Epilobium	3.4	23	5.6	0	0
Calamagrostis and *Elymus*	12.5	24	1.5	0	0
Other vegetation *Autre végétation*	0	24	1.2	0	0
Total number of nests *Nombre total de nids*	116		520	79	45

9.2. Cover at the nest site □

There was no relation between cover (overhead and total) and incidence of predation (Table 6). Abandoned nests had significantly less cover, both above and around the nest, and overall ($p<0.05$).

The degree of development of foliage did not influence the location of nests. This is reflected in the constant average total cover of the clutches initiated in grass and shrubs over the season (Table 7). Clutches initiated in grassy vegetation before the development of foliage were as well covered as those initiated afterwards. Cover provided by shrubs did not differ from that of grasses.

Cover was not equally distributed around eider nests, with substantially less cover present on east and southeast sides (Fig. 4a). A correspondence between the orientation of cover and the direction of chilling winds (Fig. 4*a* and *b*) is evident. The directions from which windchill was most severe were generally well protected. The nest entrance was usually oriented southeast, a direction from which windchill was negligible during the nesting season.

10. Discussion

The mean clutch size found at Île aux Pommes in 1977 (3.9) is comparable to clutch sizes reported by Milne and Reed (1974) for this island (3.8) and Choate (1966) for islands with the same type of vegetation in Penobscot Bay, Maine (3.8). The decline in average clutch size as the season progressed has also been reported by Milne (1974) for *S.m. mollissima*, Guignon (1967) and Paynter (1951) for *S.m. dresseri*, and Cooch (1965) for *S.m. borealis*. The decline suggests that later in the season a larger proportion of the birds present are younger or in poorer condition. Renesting also may have contributed to the phenomenon. Sarbello (1973) found up to 14% renesting in *S.m. dresseri*, and Cooch (1965) reports renesting in *S.m. borealis*. Both authors found that second clutches were smaller than first ones. Milne (1974) and Paynter (1951) believed that renesting is insignificant in the eider.

Aerial view of Ile aux Pommes
Vue aérienne de l'île aux Pommes
(photo: A. Reed)

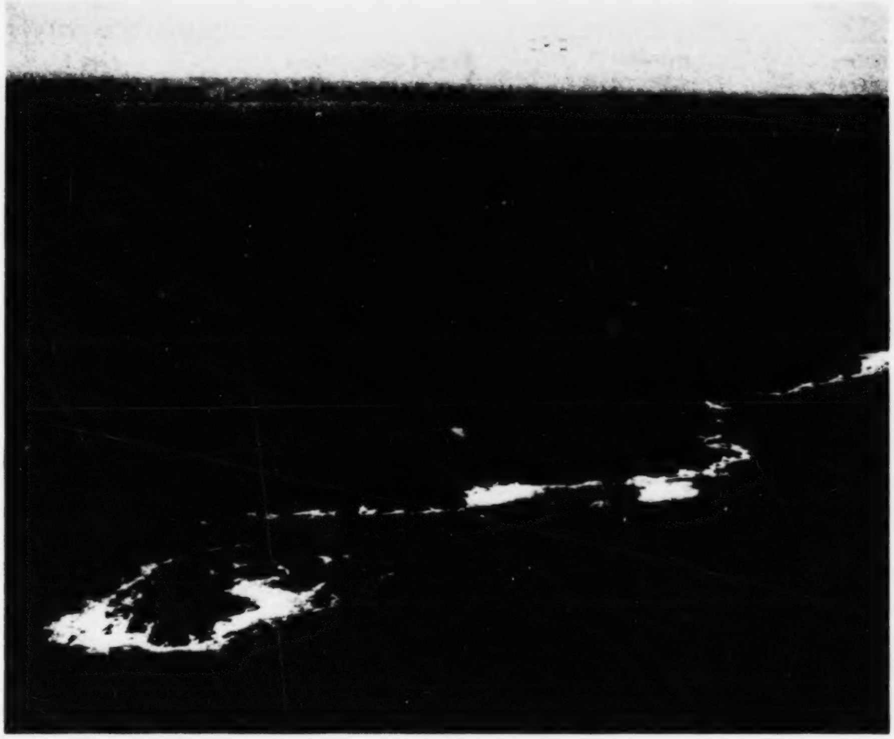


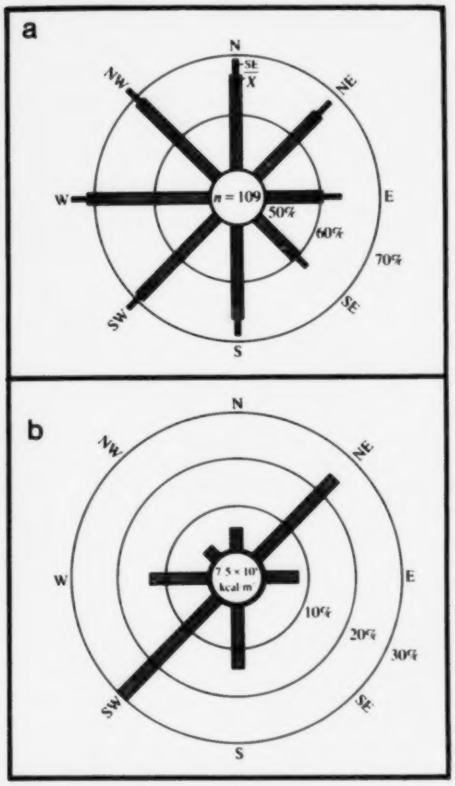
Table 6
Cover above and around individual Common Eider nests (expressed as percentage of sectors of the study grid containing cover) compared to outcome of their clutches, Ile aux Pommes, 1977
Couverture au-dessus du nid et couverture totale (exprimées en pourcentage des secteurs de grille d'étude contenant la couverture) par rapport au sort des nids d'Eider à duvet, île aux Pommes, 1977

	Nest cover, % *Couverture du nid, %*		
Outcome *Sort*	Overhead *Au-dessus*	Total	Number of nests *Nombre de nids*
Hatched *Éclos*	46.9 ± 5.42	66.3 ± 3.62	41
Taken by predation *Détruits par des prédateurs*	53.3 ± 4.60	69.3 ± 3.03	55
Abandoned *Abandonnés*	28.3 ± 6.71	47.9 ± 6.01	13
All nests *Tous les nids*	47.2 ± 3.35	65.6 ± 2.24	109

Table 7
Differences in total cover provided by grasses and shrubs for Common Eider nests, Ile aux Pommes, 1977
Différences dans la couverture fournie par les graminées et arbustes pour les nids d'Eider à duvet, île aux Pommes, 1977

	% of sectors of grid with cover (number of nests) *% des secteurs de la grille avec couverture (nombre de nids)*			
Cover type *Type de couverture*	Before 14 May *Avant le 14 mai*	15–27 May *15–27 mai*	After 27 May *Après le 27 mai*	All nests *Tous les nids*
Grass *Graminées*	66.3 ± 3.4 (22)	65.4 ± 6.6 (17)	70.0 ± 1.0 (20)	67.3 ± 2.3 (59)
Shrubs *Arbustes*	65.3 ± 7.4 (9)	71.2 ± 6.1 (14)	71.3 ± 6.5 (9)	69.6 ± 3.5 (32)
All types *Tous les types*	65.9 ± 2.9 (31)	68.0 ± 4.5 (31)	70.4 ± 2.1 (29)	68.1 ± 1.9 (91)

Figure 4
a) Distribution of cover (overhead and lateral) at Common Eider nests according to compass points and percentage of maximal possible cover (see text, and Burger 1972), Ile aux Pommes. *b*) Distribution of windchill in relation to compass points and total windchill between 24 April and 17 July 1977, at Trois-Pistoles, the nearest weather station (calculation of windchill: see Edholm and Lewis 1964)
a) Répartition de la couverture (au-dessus et autour) des nids d'Eider à duvet, par rapport aux points cardinaux et au pourcentage de couverture maximale possible (voir texte et Burger, 1972), île aux Pommes. b) *Répartition des vents refroidissants (facteur de refroidissement) du 24 avril au 17 juillet 1977 à Trois-Pistoles, la station de météorologie la plus proche (calcul du facteur de refroidissement: voir Edholm et Lewis, 1964)*



Hatching success showed a decline as the season progressed. A similar trend was found by Milne (1974), Choate (1967), and Bourget (1970).

Abandoned clutches were significantly smaller than ones that hatched and those that were lost to predation; the rate of abandonment increased over the season. Nest abandonment in this study (14.1%) was high compared to most other studies (c.f. Milne 1974, Choate 1967, Bourget 1970, and Cooch 1965), but comparable with the 11% found by Korschgen (1977). The figure may nevertheless be too low because some of the abandoned clutches were probably plundered before I found them.

The high incidence of predation (63.3%) is similar to that found by Choate (1967), Bourget (1970), and Reed (pers. commun., 1971 season) for similar islands in the estuary, and in Maine.

Factors most frequently elicited to explain failure or success of eiders breeding in gull colonies are 1) the visual and physical protection which nest cover provides against predators and 2) breeding densities of eiders and gulls. In this study, as in that of Guignon (1967), no relation was evident between the amount of overhead cover and the likelihood of predation on the clutch. This contradicts the suggestions of Choate (1967), Bourget (1970), and Milne and Reed (1974) that concealment reduces the risk of predation. Cover may also physically impede access to nests by predators. Choate (1967) found highest success in shrubby vegetation. Clark (1968) and Bourget (1970) indicated that eiders nesting under wooden shelters had high nest success. At Ile aux Pommes, hatching success in the vegetation type that provided the most physical protection against predators (shrubs) was not different from that in grassy vegetation. Most shrubs on the island did not appear luxuriant and did not provide much physical protection.

Breeding success at Ile aux Pommes was lower in areas with higher densities of nesting eiders. In mixed colonies of eiders and gulls in Maine, Choate (1967) found no relation between eider nest density and hatching success; Bourget (1970), however, observed decreased hatching success with increased eider density. My data suggest that eiders may benefit from the presence of nesting Herring Gulls as there was a positive correlation between hatching success of eiders and density of Herring Gulls. Clark (1968) also found higher nest success for eiders nesting within 5 m of Herring gull nests. This might indicate that territorial defence by Herring Gulls thwarts the attacks of non-territorial individuals and other predatory species. Despite this apparent advantage eiders did not nest in higher densities in those areas of my study area where Herring Gulls were most abundant, suggesting that other factors, such as cover, exerted an overriding influence in the choice of nest site. Great Black-backed Gulls are thought to be more predatory than Herring Gulls, and although there was no direct relation between nest density of this gull and hatching success of the eiders (see also Bourget 1970), predation on eider nests was greater than 90% in areas where the only nesting gulls were Great Black-backed Gulls.

Eiders incubate almost constantly (Belopol'skii 1961, Campbell 1975, Milne 1974), their continuous presence at the nest conferring protection against avian egg predators (Choate 1967, Bourget 1970). This behaviour results in reduced food intake (Milne 1974, Korschgen 1977) and important loss of body condition (Milne 1963, Cantin *et al.* 1974, Korschgen 1977). Some eiders deteriorate to a point where they must abandon or die on the nest (Korschgen 1977). A similar situation exists in arctic-nesting geese (Harvey 1971, Newton 1977). Birds that lose less body heat during incubation will maintain better body condition. My data on nest cover indicated that eiders chose sites that offered protection from windchill, and those that had poorer cover were more likely to abandon. The availability of nest sites sheltered from windchill may, therefore, be an important factor influencing nest site selection and hatching success in the eider.

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Nesting of the Common Eider near the Hell Gate – Cardigan Strait polynya, 1980–81

Nidification de l'Eider à duvet près de la polynie Hell Gate – détroit de Cardigan

R.W. Prach
A.R. Smith
A.Dzubin

1. Abstract

The biology of the Common Eider (*Somateria mollissima borealis*) was studied in the vicinity of Hell Gate – Cardigan Strait, which separates Devon and Ellesmere Islands in the Canadian High Arctic, during summers 1980 and 1981. There, a recurring polynya keeps shallow water feeding areas, nesting islands, and coastlines free of ice throughout spring and summer. Those conditions allow nesting populations to form distinct colonies; at most other High Arctic locations nests are widely dispersed. Aerial surveys and nest counts revealed about 635 breeding pairs, most on three small islands. In 1981, an early year phenologically, the first eggs were laid on 6 June and nest initiation terminated on 11 July with a peak occurring 25 June – 3 July. The mean clutch size in 1981 was 3.30 eggs (SD = 0.98, n = 544), a value similar to that reported for the same race in Greenland (3.31 in 1965) and Southern Baffin Island (3.12 in 1976) but less than that in Ungava Bay (3.57 in 1980) and in an earlier sample from southern Baffin Island (3.44 in 1955–56). Clutch sizes within the study area varied by year and island. Broods left the nesting islands, some of them assembling into crèches (n = 45 family groups) containing 1–17 adult females (mean = 4.6) and 1–36 ducklings (mean = 9.9), and followed the retreating ice edge into adjacent fiords and inlets. Although the typical food of the Common Eider, the blue mussel (*Mytilus edulis*), was absent from the study area, suitable food items (other molluscs, crustaceans, etc.) were available in sufficient numbers to permit successful breeding.

2. Résumé

La biologie de l'Eider à duvet (*Somateria mollissima borealis*) fut étudiée pendant les étés de 1980 et 1981 dans la région de Hell Gate – détroit de Cardigan qui sépare les îles Devon et Ellesmere dans l'Arctique canadien septentrional. À cet endroit, une polynie récurrente maintient les nappes d'eau peu profondes, où se nourrissent les eiders, ainsi que les îles et les rivages, qui servent de lieux de nidification, libres de glaces en juillet et en août. Ces conditions jouent un rôle important dans l'établissement des populations nicheuses en colonies distinctes, situation peu courante dans la plupart des autres secteurs de l'Arctique septentrional où les nids sont assez dispersés. Des relevés aériens et le recensement des nids au sol ont révélé la présence d'environ 635 couples reproducteurs dont la majorité était répartie sur trois petites îles. En 1981, année «phénologiquement» précoce, les premiers oeufs ont été pondus le 6 juin; un dernier nid a été commencé le 11 juillet; et le point culminant de la ponte est survenu entre le 25 juin et le 3 juillet. En 1981, la taille moyenne des pontes était de 3,30 oeufs (écart type = 0,98; n = 544); taille similaire à celle enregistrée chez la même sous-espèce au Groenland (3,31 en 1965) et dans le sud de l'île de Baffin (3,12 en 1976), mais inférieure à celle rapportée pour la baie d'Ungava (3,57 in 1980) et le sud de l'île de Baffin (3,44 en 1955–1956). La taille des pontes relevées dans la région étudiée varie selon les années et les îles. Les canetons et leurs mères ont quitté les îles où avait lieu la nidification pour se diriger vers les fiords et les anses à proximité en longeant le bord des glaces qui se retiraient. Certaines de ces couvées se sont rassemblées en crèches (n = 45 groupes de famille) qui contenaient de 1 à 17 femelles adultes (moyenne = 4,6) et de 1 à 36 canetons (moyenne = 9,9). Malgré l'absence de la moule bleue (*Mytilus edulis*), l'aliment de prédilection de l'Eider à duvet, d'autres proies (mollusques, crustacés, etc.) se sont avérées suffisantes en quantité pour assurer le succès de la reproduction.

3. ᓄᐃᑎᑕᐅᔪᑦ

ᐱᐅᓯᓇᔭᖓ ᒥᑎᐅᑉ (ᓱᒪᑎᓇᐊ ᒧᓪᓕᔅᓯᒪ ᐳᓇᐊᓕᔅ—Somateria mollissima borealis—ᕗᓂᖅᑕᐅᔪᖅ ᓚᑕᒥᐅᑎᑐᑦ. ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᖅ ᒪᑐᒪ Hell Gate-Cardigan Strait ᑕᓇᐅᖓᓂ ᓴᓂᕆᔭᖓᓂ. ᐊᑯᓐᓂᒍᐊᖓᓂᑦᑐᑉ Devonᒧ Ellesmere Islands-ᒧ ᑕᒪᓂ ᑲᓇᑕᐅᑉ ᑕᖅᑲᖓᓂ. ᐅᐱᕐᖓᓚᐅᖅᑕᖓᓂ 1980-ᐅᑉ 1981-ᒧ ᐊᐅᔭᖓᓂ. ᑕᒪᑦᓯᒪ ᐱᐅᓯᓇᔭᖓ ᐃᖏᖅᑲᓂᐅᓂᑯᖓᓄᑦ ᑐᑭᔪᐃᑦᑐᑎᑦᓯᐳᖅ ᐃᒃᑲᑐᓂᖏᓐᓂᒧ ᓂᓇᓯᐊᖅᐱᐅᒍᓐᓇᐱᖅᓯᓂ. ᐃᐸᕐᐅᓯᕗᑦᓯᑎᓪᒧ ᕿᑭᖅᑕᖏᑦ ᑕᒪᒃᑯᐊᒧ ᕿᑭᖅᑕᐃᑦ ᓯᓇᖏᑦ ᓯᑯᑦᑕᓯᓯᕗᓚᑎᒃ ᐅᐱᖓᓴᓕᒪᒥ ᐅᐱᖅᖓᓕᒪᒥᓪᒧ. ᑕᒪᒃᑯᐊᒧ ᐱᐅᓯᓇᔭᖏᑦ ᑕᐅᑐᑦᑕᐅᓯᒪᔪᑦ ᐃᑉᐱᕆᔭᑦᓴᒪᓇᐅᕆᐊᖏᑦ ᐊᒥᓯᕗᐸᓪᓕᐊᑎᑦᓯᓚᔭᖅᓂᒧᑦ ᐃᐸᐱᐊᖅᑐᐱᒍᓐᓇᖅᔭᖅᑎᒧᒍ ᖃᓄᐃᑦᑐᑐᐃᓐᓇᓄᑦ ᒥᑎᖅᓄᑦ ᑕᒪᓐᓇᒧ ᑕᐃᒪᐃᒍᑕᐅᔪᖅ ᐊᑦᔨᕆᔭᐅᓚᓂ ᑕᖅᑲᕆᑦᑐᐃᑦ ᐃᐸᐱᕆᓯᖏᑦᑕ ᓴᓂᐊᓂᑦ ᑕᒪᓂᓕ ᐃᐸᐱᕆᔭᖏᑦ ᐊᕆᓯᔭᖏᓪᒪᑕ ᐃᖅᐸᒋᓯᒪᑦᓯᑎᓪᒧ. ᖃᖓᑦᑕᔪᒃᑯᑦ ᖃᐅᔨᓴᖅᓂᐅᓯᒪᔪᑦ ᐊᓪᒪᒧ ᐃᐸᐱᖏᑦᑕᒧ ᑭᓯᑕᐅᓯᒪᓂᓴᔭᖏᓐᓂᒃ ᑕᐃᓯᓯᒪᔪᖅ ᒪᓐᓇᐅᔪᖅ ᒥᑦᓴᓂᓚᔭᓴᐊᖏᑦ 635 ᐊᕗᓴᓪᓗᒥᑦ. ᐃᒧᓐᓇᓕᒪᑲᓴᑎᓪᒧ ᐃᐸᓯᕗᑦᓯᑎᒃ ᐱᖓᓯᓂ ᕿᑭᖅᑕᕈᐊᐱᓐᓂ. 1981-ᒥ. ᐊᐅᔭᒍᖓ ᐱᒥᐊᖅᒥᐅᑎᓪᒧᒍ ᐅᐱᖓᓴᒥ. ᓯᐳᓪᓕᐸᖅ ᒪᓐᓂᖅ ᐃᐸᔭᐅᓐᓂᕙᖅ ᔪᓂ 6-ᕗᑎᓪᒧᒍ. ᐊᒻᒪᓗ ᐅᓪᓗᕆᐅᖅᓂᑦ ᓄᖃᓯᕗᒥᐳᑦ ᔪᓚᐃ 11-ᒥ ᒥᑎᐊᖅᑲᐃᓪᒧ ᔪᓂ 25-ᒥ ᔪᓚᐃ 3-ᒥᒧ ᐃᓄᕆᓯᕗᐳᑦ. ᒪᓐᓂᕆᐅᖅᓂᖃᓯᒪᒥᐳᖅ 1981-ᒥ 3.30-ᓂᒃ ᐊᖏᓂᕆᐱᓂᑦ (S.D.=0.98, n=544). ᑕᐃᒪᐃᑦᑐᓴᐃᓐᓇᑲᓚᐅᑦᓯᓂᒧ ᖃᐅᔨᔭᐅᓯᒪᓂᖓ ᑕᒃᑯᓇᓂᖅᓴᐃᓇᖅ ᒥᑎᖅᓂ ᐊᑯᑭᑦᑐᖅ (3.31-ᓂᒃ ᐊᖏᓂᕆᐱᓂᑦ 1965-ᕗᑎᓪᒧᒍ) ᐊᒻᒪᓗ ᓯᕿᓂᖓᓂ ᕿᑭᖅᑕᒧᑉ 3.12-ᓂᒃ ᐊᖏᓂᕆᐱᓂᑦ) ᑭᓯᐊᓂ ᒥᑭᓂᖅᓴᐅᓯᑎᒃ ᐅᖓᐸᐅᑉ ᓴᓂᐊᓂᑦ (3.57-ᓂᒃ ᐊᖏᓂᕆᓪᓂᒃ 1980-ᒥ) ᐊᒻᒪᓗ ᓯᐳᓂᖓᒍᑦ ᖃᐅᔨᓴᖅᑕᐅᒪᓂᖏᑎᒍᑦ ᒪᖓᑦ ᓯᕿᓂᖓᓂᑦ ᕿᑭᖅᑕᒧᑉ (3.44-ᓂᒃ ᐅᖏᓂᕆᐱᓂᑦ 1955–56-ᒥ) ᐅᑐᑎᒥᑦᓯᒍ ᖃᐅᔨᓴᖅᑕᐅᒪᔪᑦ ᒪᑯᑎᒍᓇ ᖃᐅᔨᓴᖅᑕᐅᒪᔪᑎᒍᑦ ᓄᓇᓂ ᓄᐃᑕᒃᑲᐃᐳᖅ ᐊᖅᑲᒍᑕᒪᓯᓂᒃ ᐊᒻᒪᓗ ᕿᑭᖅᑕᐃᑦ ᐆᒪᔪᖏᓐᓂᒃ ᐊᑦᔨᒥᓕᖏᓂᖓᓂᒃ ᒪᓐᓂᖏᑦᑕ ᐊᖏᓂᖏᓐᓂᒃ. ᒥᑎᐊᖅᑲᐃᑦ ᓄᓯᕗᒥᐳᑦ ᑕᒃᑯᓇᖓ ᐃᓚᐱᐅᔪᓂᒃ ᕿᑭᖅᑕᓂᒃ. ᐃᓚᖏᓪᒧ ᑲᑎᓯᕗᑦᓯᑎᒃ ᐃᓚᒥᑦᑎᓕᖅᓯᑎᒃ (n=45 ᐃᓚᒥᓇᖅᑎᓯᑎᒃ)

ᐊᕐᓇᓗᕐᑕᖅᓯᑎᒃ 1-ᒥ 17-ᓄᑦ (ᑐᕿᖅᕐᑐᖅ=4.6) ᐊᒻᒪᓗ 1-36-ᓂᒃ ᒥᑎᐊᕋᖅᕐᓯᑎᒃ (ᑐᑭᖅᕐᑐᖅ=9.9). ᐊᒻᒪᓗ ᓯᑯᒪᖅᑦᑕᓂᖏᑦ ᒪᑯᓇᓂ ᓯᓇᖏᓐᓂ ᐊᒻᒪᓗ ᑲᖏᕐᓱᓂ ᑕᑯᓐᓇᓂᓗ ᐹᖏᓐᓂᑦ. ᐃᒪᐃᓚᓗᐊᕐᑎᓗᒍ ᓂᕿᒋᔭᖏᑦ ᒥᑮᑦ. Blue Mussel (*Mytilus edulis*) ᓄᐃᑕᑎᑕᐅᓂᖏᓪᓚᖅ ᖃᐅᔨᓴᕐᓂᐅᔪᓂ. ᐊᓯᖏᓪᓗ ᓂᕿᒋᓪᓇᑕᖏᑦ (ᐅᑯᐊ molluscs, crustaceans, ᐊᓯᖏᓪᓗ) ᐱᑕᖃᓂᐳᑦ ᐊᒥᓱᕋᑕᐅᑦᓯᑎᒃ ᐊᒻᒪᓗ ᐊᑐᐃᓐᓇᐅᒍᓐᓇᓂᕆᔭᖏᑦ ᑲᔪᓯᒃᑲᐃᓯᐊᕈᓐᓇᕋᔭᕐᓗᓂ ᒪᓐᓂᓕᐅᕐᓂᖏᓐᓂᒃ.

4. Introduction

The northern race of the Common Eider (*Somateria mollissima borealis*) breeds on coastal islands and near marine shorelines from central Labrador to Ellesmere Island and western Greenland (Palmer 1976; Salomonsen 1950; Abraham and Finney, this publication). Prach *et al.* (1981) have reviewed their distribution and abundance in the High Arctic. The breeding biology of this race has been studied mainly on the southern portion of its Canadian range (Cooch 1965, this publication; Chapdelaine, Bourget *et al.*, this publication; Nakashima, this publication) and in Greenland (Joensen and Preuss 1972), although Hussell and Holroyd (1974) and Pattie (1977) reported on nests from the Canadian High Arctic.

This study reports on a population associated with the Hell Gate – Cardigan Strait polynya between southwestern Ellesmere Island and northwestern Devon Island. It is part of a long-term investigation on the biological importance of this open-water area to marine wildlife.

Polynyas are non-linear areas of open water surrounded by ice. Recurring polynyas, such as the Hell Gate – Cardigan Strait, are found in nearly the same position each year and have been recognized for centuries by native inhabitants of the Arctic as productive hunting grounds (Schledermann 1980). Recently scientists have become interested in the ecological phenomena associated with these fertile areas (see reviews in Stirling and Cleator 1981).

5. Study area

5.1. Location and hydrography □

The study area (Fig. 1) includes the waters, coasts, and islands of Hell Gate, Cardigan Strait, Fram Sound, Norfolk Inlet, and Walrus and Goose Fiords. Part of Hell Gate and Cardigan Strait, known unofficially as the Hell Gate – Cardigan Strait polynya, is kept open through much of the winter by a combination of set currents and tidal currents (Smith and Rigby 1981). The set (or permanent) current that flows southwards from Norwegian Bay at 1.5–3.5 knots is constricted into Hell Gate and Cardigan Strait, increasing its velocity sufficiently to prevent the formation of ice. The tidal current (about 1 knot), which flows both northwards and southwards, alternately accentuates and dampens the effect of the permanent current. The polynya usually becomes established in December as the surrounding sea freezes. The area of the polynya reaches a minimum in February expanding to about 1000 km^2 by April and about 2500 km^2 by mid-July (Smith and Rigby 1981). With break-up the polynya ceases to exist and current and wind bring ice from Norwegian Bay and Jones Sound to clog the area with varying amounts of unconsolidated, moving pack ice.

5.2. Bathymetry □

Water depth in the polynya rarely exceeds 200 m except in Fram Sound, the central portion of Hell Gate, and in Cardigan Strait, where a maximum 268 m is reached 10 km northeast of Cape Derby (Canadian Hydrographic Service 1968: map 7950). The shallow water zone (less than 100 m deep) is restricted to a strip usually less than 1 km wide along the coast, in the bays and fiords, and around small islands. North of Hell Gate and Cardigan Strait and south of Fram Sound, shallow water extends several kilometres offshore.

5.3. Topography and geology □

With the exception of the heads of bays, inlets, and fiords, the coastline is dominated by high cliffs which rise up to 300 m above sea level, usually bordered by a narrow coastal plain. Inland the land rises to heights of 550 m with permanent ice cover above 300 m. The bedrock is composed of sedimentary rocks of early Paleozoic origin (Department of Energy, Mines, and Resources 1974). Frost action and erosion by wind and water have created many irregular cliff formations and extensive talus slopes.

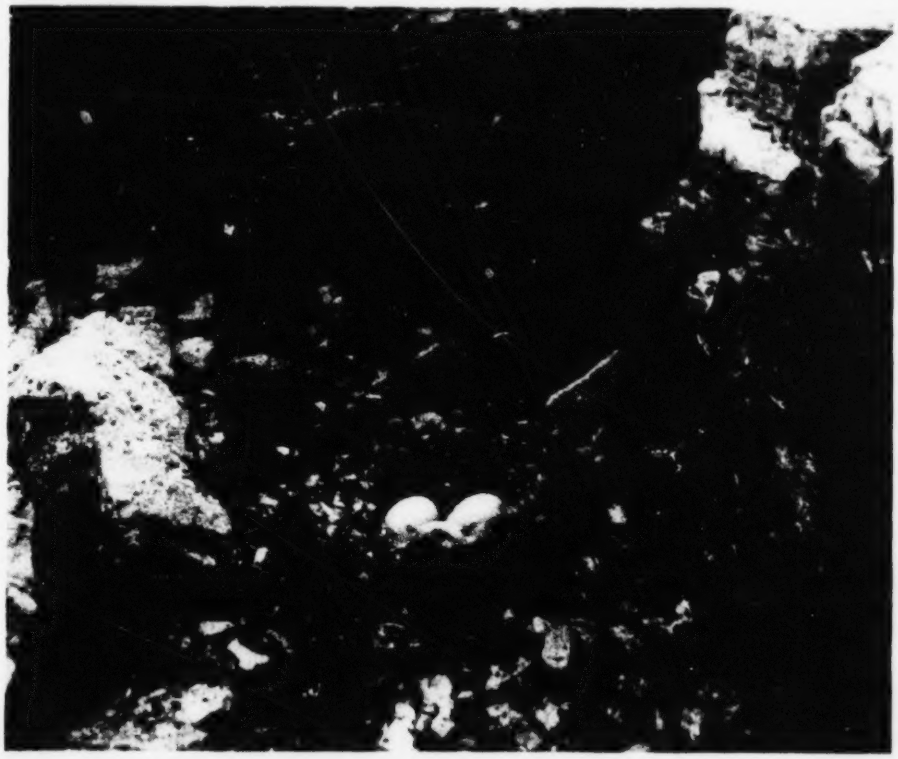
5.4. Climate □

The region of the polynya is characterized by mean January temperatures of −33°C; temperatures above 0°C occur during ca. 15 June – 25 August. Precipitation averages about 155 mm annually, of which 30–40% falls as rain (Maxwell 1981). The open water in the polynya moderates temperatures and increases fog and precipitation in the surrounding area. The topography around the polynya also has an effect as air descending the cliffs from the high plateau produces high winds and rapid increases in surface temperatures.

5.5. Vegetation □

Vegetation is sparse. Most of the ice-free land is polar semi-desert with 5–

Common Eider nest on St. Helena Island
Nid d'Eider à duvet, île Sainte-Helena
(photo: A.R. Smith)



20% cover by vascular plants (Babb and Bliss 1974). True tundra is confined to a few low-lying coastal areas. Any area with a history of continuous use by birds is marked by a conspicuous growth of the heliophytic and nitrophilous lichen (*Caloplaca elegans*), a relationship described by Salomonsen (1979).

5.6. Description of nesting islands □
St. Helena Island (76°17'N, 89°10'W). St. Helena Island (31 ha) lies about 6 km north of Cape Vera. A flat-topped core rising 70 m (the "old castle" of Sverdrup 1904) with a ridge of deeply eroded rock projecting southwards is surrounded by a flat foreshore 50–300 m wide. Small ponds are scattered over the island, which is well vegetated with *Caloplaca* in the drier sites and bryophytes in the low-lying areas. Vascular plants occur rarely and only in the vicinity of Glaucous Gull (*Larus hyperborea*) and Thayer's Gull (*L. thayeri*) nesting areas.

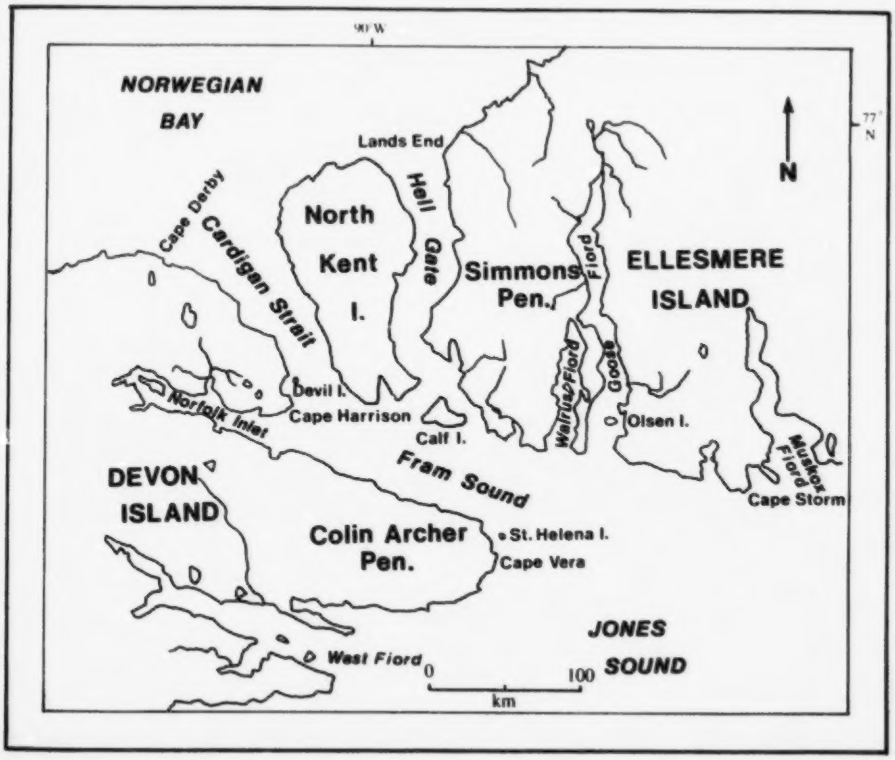
Devil Island (76°30'N, 90°28'W). Devil Island (39 ha) is 4 km north of Cape Harrison. It is dominated by a 120 m cone-shaped mountain, surrounded by a lowland up to 200 m wide. Vegetation is restricted to the southern third of the island where *Caloplaca* grows on a series of beach ridges with bryophytes growing between them. A number of ponds fill the depressions. Vascular plants occur mainly near the Thayer's Gull colony on the south slope of the "cone."

Calf Island (76°27'N, 89°30'W). Calf Island (145 ha) is triangularly shaped. It lies at the south end of Hell Gate, 3 km off Simmons Peninsula. Steep cliffs rise 200–300 m from a narrow foreshore to a relatively flat 320-m summit. An ice cap covers approximately 15% of the island. Vegetation is sparse and, as on the other islands in the polynya, restricted mainly to the vicinity of gull and eider colonies or below melting snowfields.

Olsen Island (76°27'N, 88°27'W). Olsen Island, in Goose Fiord, has an area of 113 ha and a maximum elevation of 61 m. Vegetation is generally sparse except on the southwest, which has some vegetative cover dominated by vascular plants (Duvall and Handley 1946, 1948).

Two unnamed islands occur adjacent to the polynya proper, one in Walrus Fiord (59 ha) and one in Norfolk Inlet (300 ha). We found no evidence to suggest that either is used to any extent by nesting eiders. They remained surrounded by landfast ice until early August during both 1980 and 1981.

Figure 1
Map of the Hell Gate – Cardigan Strait area
Carte de la région de Hell Gate – détroit de Cardigan



6. Methods

6.1. Aerial surveys □

We flew aerial surveys of birds and mammals on 3, 8, 14, 22, and 28 July and 9 and 14 August in 1980 and 4, 9, 21, and 29 July and 11 August in 1981. All ice-free coastlines and ice edges from Cape Derby, Devon Island, and Land's End, Ellesmere Island on the northern boundary of the polynya to Cape Vera and Cape Storm along its southern boundary were covered and all islands were circumnavigated. In 1981, additional survey segments were flown down the middle of Fram Sound, Cardigan Strait, and Hell Gate. The length of the surveys increased as the polynya expanded; the initial survey in 1981 covered 300 km of coastline and ice edge whereas the final survey covered over 630 km of coastline and ice edge. Surveys rarely exceeded 4 h.

The aircraft, a deHaviland Twin Otter, was flown at a ground speed of 185 km/h at 50 m above the water surface 200 m seaward from the coastline whenever flying conditions permitted. Three observers, one in the co-pilot's seat, and one on each side of the aircraft in the passenger compartment, counted all birds and mammals within 200 m of the aircraft, thus covering a strip approximately 400 m wide. Data were recorded on portable tape recorders.

In 1980, observations were recorded in relation to widely spaced landmarks, whereas in 1981, they were related to 2-min segments of flying time. Consequently, the 1980 survey results are not directly comparable to those of 1981; the 1980 results are presented only when they appear to differ from those of 1981.

Because there is no evidence that King Eiders (*Somateria spectabilis*) breed near the polynya, we assumed that all female eiders not associated with males during the nesting season were Common Eiders.

6.2. Terrestrial surveys □

Only portions of the coastline and islands could be covered from the ground. Areas surveyed included those reportedly used by breeding eiders (Devil, St. Helena, and Olsen Islands, and the mainland near Cape Vera) and those that appeared most suitable from the air, including portions of Calf Island, the southern isthmus on the peninsula between Walrus and Goose Fiords, and the island in Walrus Fiord.

Devil Island was visited on 7–8 July and Calf Island on 8–13 July, 1981. St. Helena Island was visited on 7 July 1980 and 6 and 13 July 1981.

Each area was systematically searched for eider nests. Observers walked slowly 10–20 m abreast in a straight line. One person recorded the data on each nest discovered. In 1981, 165 eggs in 49 nests were weighed and measured using a tubular spring scale (reading to 2 g) and vernier calipers. On a second trip to St. Helena in 1981, 135 nests were rechecked to determine the extent of egg loss over the 7-day interval between visits, and 69 eggs in 13 nests were reweighed to determine weight loss. The contents of one egg from each of 30 nests was examined to determine the stage of incubation, using criteria described by Gorman (1974). Clutch initiation dates were determined by backdating, using a mean laying rate of one per day with incubation starting the day the last egg was laid (Cooch 1965). Seven nests on St. Helena and three on Devil Island that were destroyed by predators were excluded from clutch size calculations.

7. Results and discussion

7.1. Seasonal distribution and abundance □

We could not determine whether Common Eiders overwinter in the Hell Gate – Cardigan Strait polynya as they do in the North Water off Thule, Greenland (Haig-Thomas *in* Salomonsen 1950). Renaud and Bradstreet (1980) saw no eiders on 19 April 1977 and 17 March 1978. However, Sverdrup (1904) reported "myriads of sea-birds, mostly black guillemots, but also a certain number of larger birds... probably they were eiders" on 24 March 1900. We observed eight eiders on 17 April 1980, a week later than the earliest spring record in Lancaster Sound, 10 April 1949 at Dundas Harbour (Johnson *et al.* 1976).

The bulk of the population arrives in late May. Large numbers appear around Coburg Island in early May (McLaren and McLaren 1982). They probably migrate from the North Water through Jones Sound following the same leads as migrating walrus (*Odobenus rosmarus*) (Stirling *et al.* 1981), although overland migration across Devon Island from Lancaster Sound is also possible. In 1981 the highest population count was made on 1 June, when 1915 Common Eiders were noted (Table 1, Fig. 2*a*). During the pre-breeding period eiders were concentrated in the shallow water zones, mainly within 400 m of the shoreline (Fig. 3). By the next survey (25 June) there were only 457 birds. Perhaps the polynya had been used as a staging area by Common Eiders destined for breeding sites along the north Devon coast, further west on the Grinnell Peninsula, or north on Ellesmere Island. It is also used as a staging area by King Eiders, which

Table 1
Population estimates of Northern Eiders in the Hell Gate – Cardigan Strait polynya, 1981, based on aerial counts (See Fig. 2*a*)
Nombres de Somateria mollissima borealis dans la polynie Hell Gate – détroit de Cardigan, selon des relevés aériens en 1981 (voir figure 2a)

Date	Males *Mâles*	Females *Femelles*	Young *Jeunes*	Total
June 1	969	946	0	1915
June 25	265	192	0	457
July 4	634	190	0	824
July 9	246	71	0	317
July 21	45	84	0	129
July 29	76	672	83	831
Aug 11	1	557	43	601

Figure 2
(*a*) Seasonal changes in numbers of young and adult Northern Eiders in the polynya from June through mid-August, 1981. (*b*) Span of the nesting season, 1981, showing number of clutches initiated each day ($n = 30$), estimated from eggs collected on two islands. Note the wide span of the laying period and the apparent "peak" in late June – early July
(a) Changements saisonniers dans l'abondance de Somateria mollissima borealis dans la polynie, de juin à la mi-août, 1981. (b) Durée de la saison de nidification, 1981, démontrant le nombre de pontes initiées chaque jour (n = 30), établie selon l'examen d'oeufs ramassés sur deux îles. Noter l'étendue de la période de ponte et le pic à la fin juin, début juillet

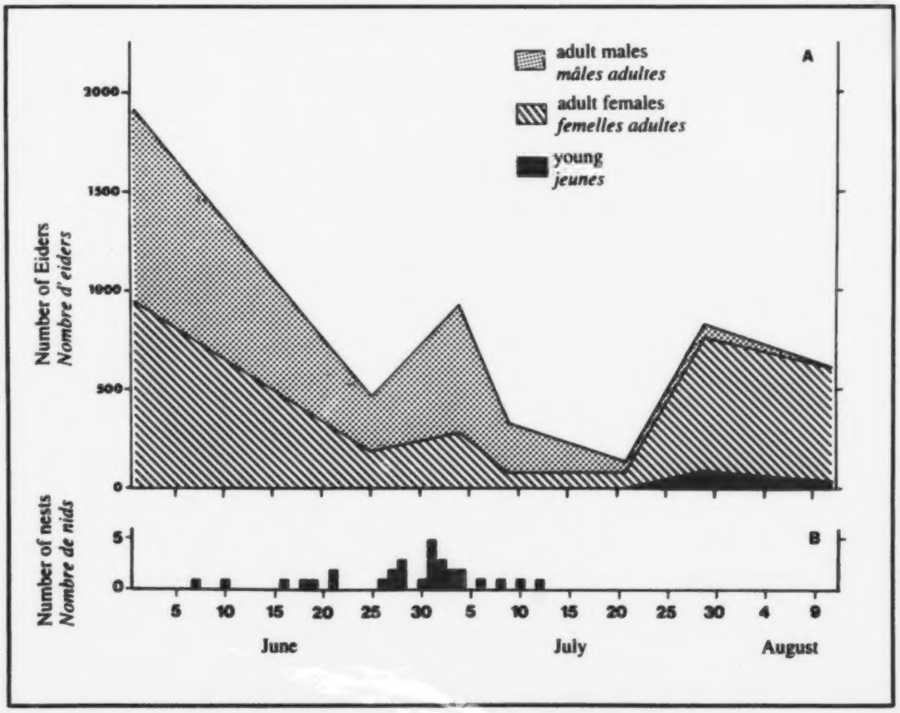
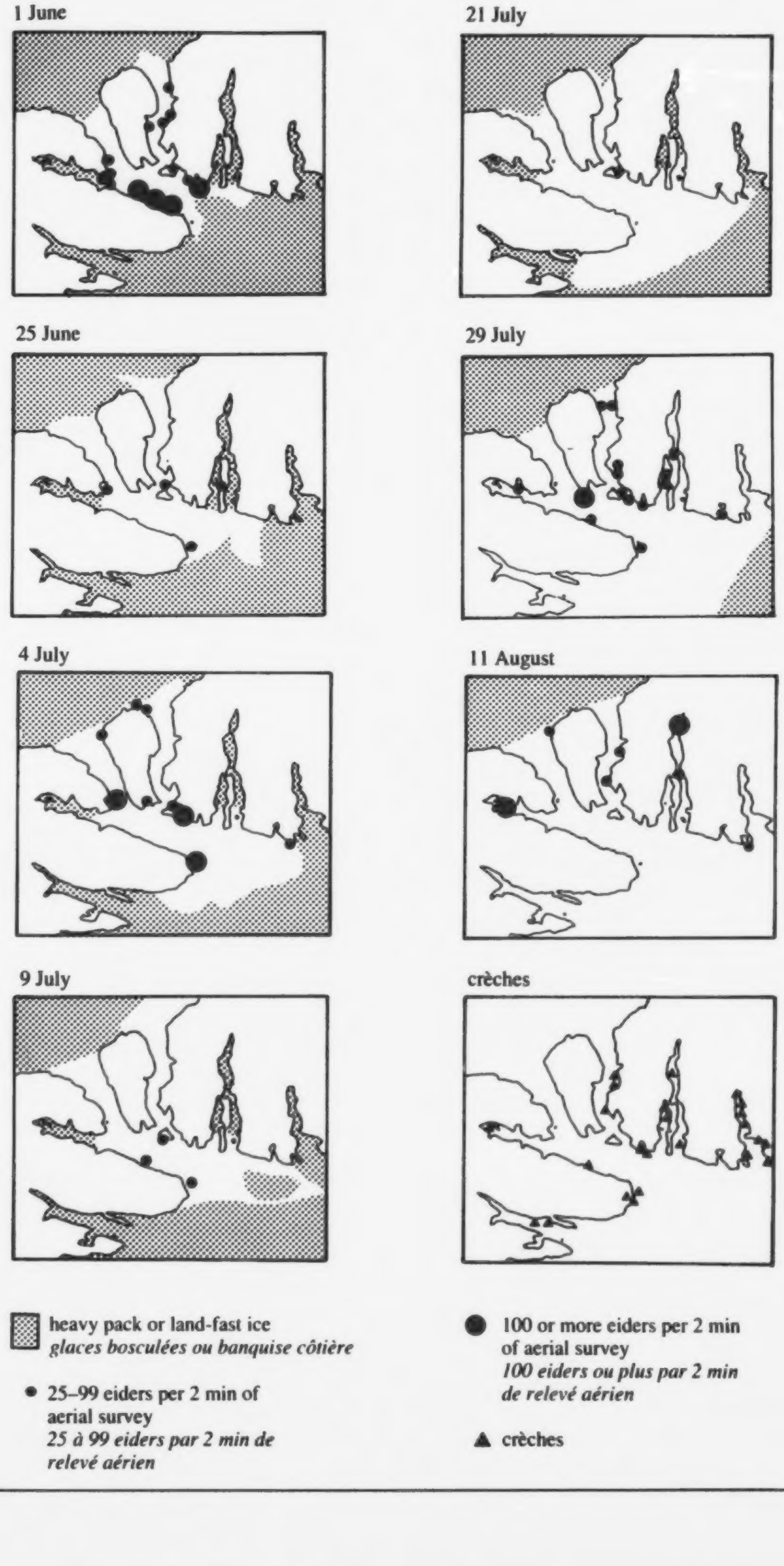


Figure 3
The seasonal location of concentrations of Northern Eiders in the polynya by date of survey in 1981. Individual pairs and small, scattered aggregations of eiders of less than 25 eiders per 2 min segment are *not* shown
La distribution saisonnière des groupements de Somateria mollissima borealis dans la polynie à différentes dates en 1981. Les couples individuels et les groupements de moins de 25 eiders par segment de 2 min ne sont pas indiqués


1 June
21 July
25 June
29 July
4 July
11 August
9 July
crèches
▨ heavy pack or land-fast ice
glaces bosculées ou banquise côtière
● 25–99 eiders per 2 min of aerial survey
25 à 99 eiders par 2 min de relevé aérien
● 100 or more eiders per 2 min of aerial survey
100 eiders ou plus par 2 min de relevé aérien
▲ crèches

breed on inland, freshwater habitats (Lamothe 1973). Their numbers declined from 375 birds on the first survey to 4 on the second.

By 25 June most Common Eiders using the polynya belonged to the local breeding population: the 25 June and 4 July surveys (Fig. 3) showed they were closely associated with the nesting islands. Fewer birds were recorded on 9 July, when most females were incubating and males had begun to leave the area. On 29 July and 11 August, more adult birds were present; females accompanied by young strongly predominated, and were widely distributed throughout the shallow water areas of the polynya and in adjacent bays and fiords. Seasonal distribution was similar in 1980 but 10 days later, reflecting a later onset of laying due to delayed ice clearance near the nesting islands and feeding grounds.

Various observations in late August suggest a gradual dispersal of females and young along the south coast of Ellesmere Island. Sverdrup (1904, vol. II:481) noted that because eiders could not fly until late in the season they remained as long as there was the smallest amount of open water. He noted eiders on the creek at Ytre Eidet on the west side of Walrus Fiord, as late as 17 October 1901.

Because of the presence of staging eiders early in the season and because locally nesting adult males and females behave differently, the survey data (Table 1) do not show a consistent number of adult birds throughout the season. Lock (this publication) has shown that a count of adult males at a time when most females have just begun incubation can provide an accurate estimate of breeding pairs. The survey of 4 July 1981, appropriately timed in this respect, revealed the presence of 634 adult males. Similar numbers of adult females were in the final two surveys, when the hatch had been completed. The difference between the 554 nests found and 634 breeding pairs is about right, given that a complete nest search was not possible on mainland shorelines.

7.2. Nesting distribution and habitats □

Sverdrup and Bay *in* Sverdrup (1904) mention both St. Helena and Devil Island as eider breeding locations. Schaaning (1933) noted a clutch of two eggs from southern Ellesmere Island on 22 July 1901. Duvall and Handley (1948) report the finding of "several nests" on Olsen Island in summer 1947. These are the only published nesting records prior to the initiation of the present study.

In 1980, we found Northern Eiders breeding on Devon Island near Cape Vera and on St. Helena Island. Near Cape Vera we found six nests and many old nest bowls. Former Inuit camp sites and islands in small ponds were favoured locations. On St. Helena Island we found 140 nests.

In 1981, we found no evidence of nesting on the mainland near Cape Vera. We found 303 nests on St. Helena Island, 141 on Devil Island, and 110 nests on Calf Island. No eider nests were found on Olsen Island or on the isthmus between Muskox and Goose Fiords but the presence of nest bowls indicated historical use.

Eiders used a variety of substrates on the marine islands for nesting. In decreasing order of use these were (1) old beach ridges up to 200 m from salt water and interspersed with rocks, low cliffs, and ponds; (2) cliff ledges, the bases of cliffs, or sites near large bedrock erratics; (3) raised beach ridges adjacent to the land-fast ice front or marine coast (Devil Island); (4) the tops of cliffs or boulders 2–10 m high; (5) structures made by people (Sverdrup 1904, Vol. II:300; Porsild 1938); (6) talus slopes especially at the bottom edge next to raised beaches; (7) caves or pockets in rock massives up to 60 m high; and (8) boulder fields containing marine eroded rocks 10–500 cm in diameter.

Bryophytes, seaweeds, and dead saxifrage material had been accumulated in some nest bowls but most had none. One nest was found on a raised beach 1 m from a permanent snowfield and another was located 10 m below the central massive on St. Helena Island under a boulder.

7.3. Nest initiation dates □

In 1981, examination of embryos from 30 nests revealed that eiders began to lay during a 36-day period, 6 June – 11 July inclusive (Fig. 2*b*). Sixty percent of the nests were started between 25 June and 3 July. Cooch (1965) reported first eggs near Cape Dorset on 19 June 1955 and 23 June 1956 with laying periods of 24 and 25 days and a peak of nest initiation from 25 June to 5 July in both years. It is surprising to find an earlier onset and a longer span of laying at Hell Gate – Cardi-

Table 2
Lengths and widths of Northern Eider eggs on St. Helena and Devil Islands, 1981, compared with other areas
Dimensions des oeufs de Somateria mollissima borealis aux îles Sainte-Helena et Devil, 1981, et dans d'autres régions

Island or area *Île ou région*	Sample size *Taille de l'échantillon*	Mean length, mm *Longueur moyenne, mm*	SD ET*	Mean width, mm *Largeur moyenne, mm*	SD ET	Minimum and maximum / *Minimum et maximum* Length *Longueur*	 Width *Largeur*	Authority *Référence*
St. Helena	105	74.0	3.3	49.7	1.4	67.8–81.8	44.5–53.3	This study *Cette étude*
Devil	53	75.8	3.3	49.6	1.7	68.2–83.0	46.0–53.2	This study *Cette étude*
Pooled *Les deux*	158	74.6	3.4	49.6	1.5	67.8–81.8	44.5–53.3	This study *Cette étude*
Hopedale, Labrador	103	77.1		50.9				Gross (1938)
Various collections *Données variées*	76	75.4		50.4		73.2–83.0	46.0–53.0	Bent (1925)
Greenland	80	76.0		48.3				Schiøler *in* Salomonsen (1950)

**Écart type*

Table 3
Frequency of clutch sizes of Northern Eiders from the Hell Gate – Cardigan Strait area compared with southern Baffin Island and western Greenland
Fréquence de la taille des pontes de Somateria mollissima borealis dans la région de Hell Gate – détroit de Cardigan et dans le sud de l'île de Baffin et l'ouest du Groenland

Area *Région*	Year *Année*	Clutch size / *Taille de la ponte* 1	 2	 3	 4	 5	 6	 7	 8	Total nests *Nbre de nids*	Mean size *Taille moyenne*	One SD *Un écart type*	Authority *Référence*
St. Helena Island	1980	19	32	58	31	—	—	—	—	140	2.72*	0.96	This study *Cette étude*
	1981	13	48	105	116	14	—	—	—	296	3.24	0.93	This study *Cette étude*
Calf Island	1981	5	20	45	31	6	3	—	—	110	3.20	1.04	This study *Cette étude*
Devil Island	1981	7	15	28	76	11	1	—	—	138	3.52	0.99	This study *Cette étude*
All 3 polynya islands *Les trois îles*	1981	25	83	178	223	31	4	—	—	544	3.30	0.98	This study *Cette étude*
Cape Dorset, Baffin Island	1955 1956	48	211	520	669	118	24	8	—	1598	3.44	0.99	Cooch (1965)
Cape Dorset, Baffin Island	1976	42	77	134	143	28	5	—	—	429	3.12	1.12	Cooch (this publ.) *Présente publ.*
Upernavik, northwest Greenland	1965	62	216	416	479	102	21	2	1	1299	3.31	1.06	Joensen and Preuss (1972)

*May include some incomplete clutches (see text).

** Peut comprendre quelques pontes incomplètes (voir texte).*

gan Strait, 1500 km north of Cape Dorset, although 1981 was an early melt year with accelerated sea ice break-up in the polynya.

7.4. Egg sizes and weights □

The mean weight of 13 unincubated eggs was 103.8 g (± 1 SE of 1.6 g) and another 27 that had been incubated 1–4 days weighed 99.2 ± 1.4 g. The weight of 69 eggs from 29 clutches decreased at an estimated rate of 0.54 g/day during incubation ($y = 101.8-[0.54 \text{ g} \times \text{days of incubation}]$); the regression line did not differ significantly from zero ($P>0.05$) and the predictability between egg weight and days of incubation was low ($r^2 = 0.26$), reflecting small sample sizes, high variability in egg weights and imprecise aging techniques (cf. Baillie and Milne 1982). On St. Helena Island 45 eggs which had been incubated 1–17 days weighed 99.6 ± 1.0 g on 6 July 1981 and 94.2 ± 1.0 g seven days later, an average loss of 0.77 g/day/egg. The latter estimate of weight loss better approximates expected losses assuming that ducklings weigh about 64 g (Koskimies and Lahti 1964) at hatch.

The mean of the lengths and widths of 158 eggs was 74.57 ± 0.27 mm by 49.63 ± 0.12 mm (Table 2). There were no significant differences in egg measurements between Devil and St. Helena Islands, nor from those reported for other breeding locations of this race (Table 2).

7.5. Clutch size □

The clutch sizes recorded in this study (Table 3) represent the actual number of eggs in each nest at the time of the count, uncorrected for eggs lost to predators or for uncompleted clutches. Mean size of a sample of 135 clutches taken on 13 July on St. Helena Island did not differ significantly from the 296 (Table 3) found on 6 July (3.13, SD 0.98 vs. 3.24, SD 0.93). The mean clutch size for all three islands in 1981, 3.30 eggs, is similar to those reported from Greenland in 1892 (Gibson 1922) and in 1965 (Joensen and Preuss 1972) and Cape Dorset in 1976 (Cooch, this publication). An earlier study at Cape Dorset (Cooch 1965) showed a higher mean clutch size (3.44). A recent study in Ungava Bay (Chapdelaine, Bourget *et al.*, this publication) revealed a mean clutch size of 3.57 eggs.

Mean clutch size on St. Helena Island was smaller in 1980 than in 1981 ($t = 5.39$, $P<0.01$). In 1981 Devil Island had a significantly larger mean clutch than either St. Helena or Calf Island, but the difference between the latter two islands was not significant.

7.6. Broods and crèches □

From 28 July to 19 August 1980, 34 crèches were observed, 25 of which were counted; the mean number of hens per group was 3.3 (range 1–17) whereas the mean number of ducklings was 8.3 (range 1–26). In 1981, between 27 July and 16 August, 24 crèches were seen; in the 20 crèches that could be accurately counted, the mean number of hens was 6.3 (range 1–15) whereas the mean number of ducklings was 11.9 (range 2–36). The mean number of ducklings per female varied from 10.0 (10 ducklings with 1 hen) to 0.18 (3 ducklings with 17 hens) in 1980 and from 6.0 (12 ducklings and 2 hens) to 0.47 (7 ducklings with 15 hens) in 1981. Mendenhall (1979) reported similar ranges in Scotland for the European Eider (*S. m. mollissima*).

8. Summary and conclusions

In contrast to the dispersed nesting by Common Eiders that occurs elsewhere in the high arctic islands, the Hell Gate – Cardigan Strait polynya supports dense colonial nesting where there are open water, providing adult females and young access to high protein food, and ice-free marine islands, providing security.

Over most of its range the Common Eider is considered to be a specialist feeder, relying heavily on the blue mussel (*Mytilus edulis*). In Canada the Common Eider is sympatric with the blue mussel, except in an area north of Lancaster Sound including the present study area (Lubinsky 1980). That apparent feeding relationship applies principally to wintering and staging areas where most studies have been conducted. In the breeding season a more varied diet is often evident with gastropods, crustaceans, annelids, and fish eggs being important (Cantin *et al.* 1974). Such must be the case in the Hell Gate – Cardigan Strait polynya where the blue mussel is absent but other potential prey items are present in considerable abundance. Our reference collection of invertebrate fauna from the polynya contains numerous species that are potential food items for eiders, such as the bivalves *Astarte*, *Hiatella*, *Macoma*, *Musculus*, and *Mya*. The area is recognized as a wintering ground for walrus, a species that generally overwinters in areas with productive bivalve communities in shallow water (Kiliaan and Stirling 1978, Stirling *et al.* 1981).

Immediately prior to laying their eggs, female eiders feed heavily to take on body reserves required for egg production (Milne 1974, Korschgen 1977). The Hell Gate – Cardigan Strait polynya provides an area of ice-free marine water, giving females access to food resources.

The importance of the biologically active boundary between melting ice and the marine environment has been recognized for a number of years (c.f. Dunbar 1981). Phytoplankton concentrate below and around ice-edges, attracting other cryofauna and their predators, including seabirds (Divoky 1979, Bradstreet 1982). Local concentrations of feeding adult Northern Fulmars (*Fulmarus glacialis*), Black Guillemots (*Cepphus grylle*), and Northern Eiders were readily apparent during aerial surveys along the melting edges in the southern portion of the expanding polynya in June and early July, attesting to the productivity of this zone. Furthermore, the expansion of the summer melt into Walrus and Goose Fiords and Norfolk Inlet (Fig. 1) provided another biologically productive feeding zone for newly hatched eiders after July. Eider crèches were associated with such boundaries and moved up the fiords with the melt. Possibly these adult female and young eiders share ice-free bivalve beds with the walrus which occur in these same areas.

The Common Eider is most commonly found breeding on offshore islands (Bellrose 1976, Cramp 1977) and on islands in freshwater ponds near the coast (Pattie 1977; this study; Nakashima, this publication). Extensive use of small marine islands by nesting eiders has been explained as a defence against the heavy predation exacted elsewhere by arctic foxes (*Alopex lagopus*) and other terrestrial predators (Larson 1960, Løvenskiold 1964; Lack 1968; Nakashima, this publication). Ahlen and Andersson (1970) and Divoky (1979) indicated that if ice contact between an island and the mainland persisted into the nesting season, predation by foxes may preclude eider colonies. Instead of risking predation, eiders may curtail breeding (Rosenburg *et al.*, 1970; Nakashima, this publication).

Eiders are rare in locations as far north as Axel Heiberg Island (Macpherson 1963) and west-central Ellesmere Island (Parmelee and MacDonald 1960). The absence of breeding eiders is attributed to ice-covered seas and the lack of marine islands. The presence of ice-free islands found in polynyas such as those near Flagler Bay, east central Ellesmere Island, (Schledermann 1980), Penny Strait (S.D. MacDonald, pers. commun.), or Hell Gate – Cardigan Strait appears to be a prerequisite for continuous breeding in large aggregations in the High Arctic. Indeed, Bay (*in* Sverdrup 1904) commented that Devil and St. Helena Islands were the only "bird islands" found during extensive exploration of the eastern Queen Elizabeth Islands between 1899 and 1902.

Calf Island qualifies as a "bird island" as well, whereas Olsen Island is of marginal significance. On 14 July 1980, we observed approximately 160 eiders near Olsen Island. Although we conducted no ground surveys to confirm active nesting, such concentrations have usually been associated with breeding colonies. In 1981, when Olsen Island was ice-bound, no such concentrations were observed. The ecological significance of these bird islands and the Hell Gate – Cardigan Strait polynya has long been recognized (Revel 1981).

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Part V Use by people

Section V Utilisation faite par l'homme

Inuk in parka made from eiders' skins, Belcher Islands, 1968
Inuk portant un anorak fabriqué de peaux d'eiders, îles Belcher, 1968
(photo: F. Bruemmer)

Inuk with down harvested from eider nest, Frobisher Bay
Inuk avec du duvet ramassé dans des nids d'eider près de Frobisher Bay
(photo: F. Bruemmer)

Eiderdown harvesting and other uses of Common Eiders in spring and summer

Cueillette du duvet et autres utilisations de l'Eider à duvet au printemps et en été

A. Reed

1. Abstract

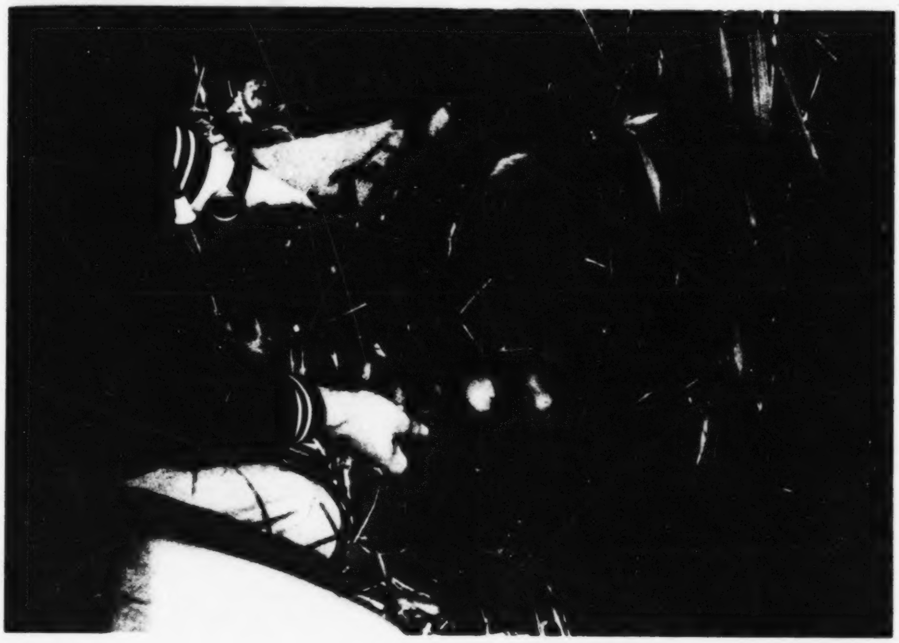
During spring and summer Common Eiders (*Somateria mollissima*) are used by Canadians for many purposes. In the north, Inuit hunters take eggs and adult birds for food. In some localities they make garments from eider skins and collect quantities of down, some of which is used locally to stuff outer clothing and sleeping bags, and some sold on the commercial market. In southern Canada egging and shooting have been almost totally eliminated during the breeding season but down-harvesting is permitted, now being carried out principally in the St. Lawrence estuary. Breeding eiders are excellent subjects for scientific research, photography, and natural history studies. In northern areas certain biological and socio-cultural criteria lend justification to the harvesting of eiders and their eggs for food, but in some areas the harvest may be excessive; to obtain a given quantity of food, harvesting eggs will have less impact on eider populations than harvesting adult birds. The potential commercial harvest of eiderdown is tentatively established at ca. 280 kg of cleaned down for the eastern Arctic and 220 kg for Atlantic Canada, although at present less than 250 kg are marketed annually. Harvesting of this valuable product can, however, affect eider nest success and if practised on a large enough scale may reduce or eliminate options for other forms of use such as exploitation for food in the north or wildlife viewing in the urbanized south. Rational management of the species requires a blending of uses that will, while ensuring the maintenance of healthy populations, optimize the benefits that can be derived from it.

2. Résumé

Au printemps et en été, l'Eider à duvet (*Somateria mollissima*) fait l'objet de différentes formes d'exploitation par des Canadiens. Les Inuit dans le nord du pays prennent des eiders et leurs oeufs pour se nourrir. En certains endroits, ils fabriquent des vêtements avec des peaux d'eider et cueillent le duvet pour bourrer des vêtements et sacs de couchage et pour vendre sur le marché commercial. Dans le sud du pays, la chasse et le ramassage des oeufs ont été presque totalement éliminés durant la période de reproduction, mais la cueillette de duvet est autorisée et se pratique principalement dans l'estuaire du Saint-Laurent. En période de reproduction, l'Eider à duvet demeure un sujet d'intérêt particulier pour des chercheurs scientifiques, des photographes et des fervants de l'histoire naturelle. Dans les régions nordiques, certaines réalités socio-culturelles et biologiques justifient les prises d'eiders et de leurs oeufs comme nourriture, mais en quelques endroits, le niveau d'exploitation est peut-être excessif; le ramassage des oeufs pourrait fournir une quantité donnée de nourriture, avec moins d'impact sur la population d'eider que les prises d'eiders adultes. Les quantités de duvet potentiellement disponibles ont été établies à environ 280 kg (duvet épuré) pour l'est de l'Arctique et 220 kg pour les provinces atlantiques. À présent, moins de 250 kg est mis en marché annuellement. La cueillette de ce produit précieux peut quand même influencer le succès de la reproduction de l'espèce et, si pratiquée à grande échelle, réduire ou éliminer des options en regard d'autres formes d'utilisation, telle la chasse de subsistance dans le Nord ou l'observation de la faune dans les régions urbanisées du Sud. L'aménagement rationnel de l'espèce demande l'harmonisation des différentes formes d'utilisation à un niveau qui assurera le bien-être des eiders tout en optimisant les avantages dont l'homme peut bénéficier.

3. ᓄᐃᑎᑕᐅᔪᑦ

ᐅᐱᖓᓴᐅᑎᓪᓗᒍ ᐅᐱᖓᒥᓗ ᒥᑎᑦ ᐊᑐᕐᑕᐅᓯᕗᐳᑦ ᑲᓇᑕᒥᐅᓄᑦ ᓯᓇᑐᐃ·ᓇᓕᒪᓄᑦ. ᑕᕐᕋᒥ ᐃᓄᐃᑦ ᒪᒃᐃᑦᑎᑦ ᐅᒪᔪᕐᓂᐊᑎᑦ ᒪ·ᓂᔭᐃᓯᕗᐳᑦ ᐊᒻᒪᓗ ᓂᕿᕆᑦᓯᕆᑦ. ᐊᓯᕙ·ᓂᓗ ᓄᓇᓕ·ᓂ ᐊ·ᓄᕋᓕᐅᓯᕗᐳᑦ ᒥᕚᕙ·ᓂᒃ ᓄᐊᑦᔪᓯᕗᑦᓯᑎᓪᓗ ᕙᓂᒍᕙ·ᓂᒃ. ᐊᑐᕐᑕᐅᓯᕗᑦᓯᑎᓪᓗ ᐊ·ᓄᕋᓄᑦ ᕙᓂᒍᕆᔭᐅᑦᓯᑎᒃ ᕿᐱᕆᔭᐅᑦᓯᑎᓪᓗᓂᑦ. ᐊᒻᒪᓗ ᐃᓚᕙᑦ ᓂᐅᕈᑎᐅᓯᕗᑦᓯᑎᒃ ᑭᓇᐅᔭᓕᐅᕋᓯᐊᕐᓂᒍᑦ. ᑲᓇᑕᐅᑉ ᓯᕿᓂᖓᓂ ᒪ·ᓂᔭᐃᓂᖅ ᕙᑭᐊᓂᕐᓗ ᐃᓗ·ᓇᑲᓴᖓ ᓄᒃᑎᑕᐅᒪᔪᖅ ᒪ·ᓂᓕᐅᒃᓂᕙᓂ ᑭᓯᐊᓂ ᕙᓂᒍᐃᔭᕐᑕᐅᒍ·ᓇᓯᕗᒐᓗᐊᑦ. ᒪ·ᓇᐅᔪᖅ ᑕᐃᒪᐃ·ᓂᒃᓯᓂ St-Lawrence ᑰᖓᑕ ᐸᖓᓂ. ᒪ·ᓂᓕᐅᕐᑐᑦ ᒥᑎᑦ ᐊᑲᐅᔪᕐᑕᐅᔪᑦ ᑲᐅᔾᓴᕐᑎᓄᑦ ᒃᐅᔾᓴᕈᑕᐅᑦᓯᑎᒃ ᐊᓪᓗ ᐊᑦᔾᓕᐅᕿᕐᓄᑦ ᐊᑲᐅᒥᔭᕐᑕᐅᑉᓪᓕᐊᑐᐃ·ᓇᓯᑎᒃ ᐊᒻᒪᓗ ᐱᐸᓪᓕᐊᓂᓴᔭᖓᑕ ᐱᐅᓯᓴᔭᖓᒍᑦ. ᑕᕐᕋᒥᓕ ᖃᓄᐃ·ᓂᓴᔭᖓ ᐊᒻᒪᓗ ᐃᓄᓯᖓᑕ-ᐱᐅᓯᓴᔭᖓ ᐱᓇᓱᑦᑕᐅᓂᓴᔭᖓᓄᑦ ᐱᔭᐅᒃᑦᑕᓂᕙ·ᓄᑦ ᒥᑎᑦ ᐊᒻᒪᓗ ᒪ·ᓂᕙᑦᑕ ᓂᕿᕆᔭᐅᑦᓯᑎᒃ. ᑭᓯᐊᓂ ᓄᓇᓕᑦ ᐊᓯᕙ·ᓂᒃᒥᑎᕐᓂᐊᓗᐊᕐᓂᒃᑐᓴᐅᔪᖅ; ᐃᓯᒪᕆᔭᐅᓯᒪᔪᖅ ᑕᒪ·ᓇ ᓂᕿᒃᑎᓯᓂᖅ ᒪ·ᓂᔭᐃᓂᖅ ᐱᐱᑦᑕᒃᑎᓯᓪᓗᐊᓕᖓᕙᓚᖅ ᒥᑎᕐᓂᒃ ᐅᑯᐊ ᓴᓂᐊᓂᑦ ᐱᕈᕐᓯᒪᓕᕐᑐᐃᑦ ᒥᑎᑦ. ᕿᓇᐅᔭᓕᐊᕋᓯᐊᕐᓂᐅᓚᔭᕐᑐᖅ ᕙᓂᒍᕙᑎᒍᑦ ᓄᐃᑕᐅᓚᔭᕐᓂᒃᐸᐳᖅ ᐃᒪᐃᓪᓗᐊᓗᓂ 280 ᐅᕙᒪᐃ·ᓂᑦ ᓴᓗᒻᒪᓴᕐᓯᒪᑦᓯᑎᒃ ᕙᓂᒍᐃᑦ ᑕᕐᕋᐅᑉ ᒥᑦᓴᓂ ᐊᒻᒪᓗ 220 ᐅᕙᒪᐃ·ᓂᑦ ᐊᑦᓚ·ᑎᒃ ᑲᓇᑕᒥ. ᐃᒪᐃᓚᓗᐊᕐᑎᓗᒍ ᒪ·ᓇᐅᔪᒃᑯᑦ ᐃᑭ·ᓂᓴᐃᑦ 250 ᐅᕙᒪᐃ·ᓂᓂᒃ ᓂᐅᕈᑎᐅᓯᕗᐳᑦ ᐊᕐᕋᒍᑕᒪᑦ. ᕿᓇᐅᔭᓕᐅᕋᓯᐊᕐᓂᒍᑦ ᑕᒪᑐᒎᖓ ᐊᑐᓂᒃᓪᒪᓇᒻᒎᑦ ᐃᒪᐃᑦᓯᒍ·ᓇᕙᖅ. ᑭᓯᐊᓂ ᐊᑦᑐᐃᓂᒃᓯᕗᐳᑦ ᒥᑦᒪᓂᓕᐅᕐᐱᕙ·ᓂᒃ ᐊᒻᒪᓗ ᑕᐃᒪᐃᒍᑕᐅᒍᓂ ᐊᕙᔪᑎᒥᓗᓂ ᐃᑭᓕᒥᐊᑐᐃ·ᓇᓇᐊᒃᑲᓴᕐᐳᖅ ᐅ·ᐸᓗ·ᓂᑦ ᓄᕗᓐᓗᓂ ᐊᓯᐊᒍᑦ ᐊᑐᕐᑕᒎ·ᓇᓂᓇᓚᓴᕐᑕᕙ·ᓂᒃ ᓂᕿᒃᓴᓯᐊᕐᓂᑐᐃ·ᓇᒎᐊᖓᒍᓂ ᑕᒪᓂ ᑕᕐᕋᒥ ᐅ·ᐸᓗ·ᓂᑦ ᐅᒪᔪᐃᑦ ᑕᐅᑦᑕᐅᓂᖓᑎᒍᑦ ᓄᓇᓯᒪᓂᓴᖓᓂ ᓯᕿᓂᕐᒥ. ᐊᐅᓚᑦᓯᓂᖅ ᑕᒪᒃᑯᓂᖓ ᐅᒪᔪᓂᒃ ᑲᒪᕆᔭᐅᑦᓯᐊᓇᐊᖅᓪᒪᓇ<ᐳᖅ ᐊᑐᕐᑕᐅᓂᕙᑎᒍᑦ ᐃᒪᐃᑎᓯᒪᔪᕐᒪᑦ. ᓯᕐᕿᐃᓯᒪᓯᐊᕐᓂᑯᑦ ᑕᒪᐃᓕᖓᐃ·ᓇᑎᑦᓯᒪᔪᐊᕐᓂᕐᒥᑉ ᐊᕐᓂᕐᒥᒃ ᒥᑎᖅᕙ·ᓇᕗᕈᑦ. ᓇᓄᐃᕐᓯᓂᕐᓗ ᐱᐸᓪᓕᕗᑎᑦᓴᑎᒍᑦ ᐱᔭᐅᓴᕐᓂᕙᑎᒍᑦ ᑕᑯᓇᖓᑦ ᒥᑎᕐᓂᑦ ᕙᓂᒍᕙ·ᓂᓗ.



Eider down can be collected in Canada only under permits issued by CWS. Collectors carefully remove the eggs from the nest and remove only a portion of the down, leaving enough to insulate and camouflage the eggs (which are immediately returned to the nest). Collectors are required to minimize disturbance to the nesting birds.
La cueillette de l'édredon peut se pratiquer au Canada seulement si le cueilleur est muni d'un permis spécial émis par le Service canadien de la faune. Le cueilleur place les oeufs à l'extérieur du nid et n'enlève qu'une fraction du duvet, afin d'en laisser suffisamment pour garder les oeufs chauds (qui sont immédiatement replacés dans le nid) et pour les abriter de la vue des prédateurs en attendant le retour de la canne. Les cueilleurs doivent également prendre d'autres précautions afin de minimiser le dérangement des eiders.
(photo: J. Bédard)

4. Introduction

Peoples inhabiting coastal areas of the northern portion of the globe have benefited from the presence of eiders for millenia. Meat, eggs, skins, feathers, and nest-down contributed to the survival of residents and early travellers. The long, rich history of the exploitation of Common Eiders (*Somateria mollissima*) in the USSR, Scandinavia, Britain, Iceland, and Greenland is described by Palmer (1976) and Doughty (1979). The well known and successful situation in Iceland, where special care and protection of eiders has led to a thriving eiderdown industry, has been described by Pettingill (1959), Munro (1961), Palmer (1976), and Doughty (1979).

In Canada and Alaska eiders have been exploited by indigenous peoples, principally Inuit, for many centuries, a practice still important to the subsistence economy in a few northern locations. In the Gulf of St. Lawrence feathers and eggs were important export commodities in previous centuries (Bruemmer 1979, Blanchard 1984), leading to the near-extinction of the local population.

In addition to providing valuable products, eiders have contributed to our cultural richness. Amongst Inuit tribes special devices for hunting eiders and methods of preserving its eggs have evolved. Eiders form the basis of certain native rituals and are present in the art and folklore of Native and European cultures. In today's increasingly urbanized society there is a strong demand for recreational, wildlife-oriented experiences; in this context the special excitement, colour, and intrigue associated with eiders in the breeding season offers a potential that has as yet been only lightly exploited, despite the relative accessibility of some breeding locations.

This contribution represents an attempt to document such associations between people and eiders in eastern Canada, and to explore their implications for effective conservation.

5. Harvesting eiderdown in Canada

5.1. A brief history of eiderdown harvesting □

The history of eiderdown collection in arctic Canada is poorly documented. The Inuit of the Belcher Islands, the Quebec coast of Hudson Bay and Greenland made fine parkas and pants from eider skins with the down and, in some cases, feathers attached, whereas those of other areas of northern Quebec made inner socks from the same material (Palmer 1976, Munro 1961, Bruemmer 1971, Kemp *et al.* 1982). But the use of detached down to stuff the linings of garments and sleeping robes may not have been practised until traders made woven cloth (to contain the down) available to the Inuit (Kemp *et al.* 1982), probably within the past two centuries. Stone nest shelters on Baffin Island (Munro 1961) were formerly thought to represent evidence of down-harvesting instigated by Viking occupation in ancient times, but were more likely devices to facilitate the capture of nesting females (W.B. Kemp, pers. commun.). The collection of nest down was in regular practice near Hudson Strait and the Labrador coast in the late 19th century and some was exported (Cooch 1965, Palmer 1976, Doughty 1979). In the 18th century a flourishing trade in feathers (presumably including nest down) was wreaking havoc in eider and other seabird colonies in the Gulf of St. Lawrence and the Maritimes (Blanchard 1984). The feather trade dwindled in the following century as commercial exploitation of eggs took over, but as bird populations declined neither product could be collected in profitable quantity. Commercial trade had all but ceased by the turn of the present century but on the north shore of the Gulf of St. Lawrence exploitation of eiders and their eggs for domestic use continued to affect the bird population.

From the start of the present century through to the present, Inuit harvested small quantities of down for their own use, principally at locations along the west coast of Ungava Bay (Kemp *et al.* 1982) and near Cape Dorset (Cooch 1965). Attempts to establish a commercially viable industry began shortly after the signing of the Migratory Birds Convention (1916) which afforded special protection to eiders. From 1925 to 1935, with strong encouragement from federal wildlife authorities, a small operation began in the Gulf of St. Lawrence (Lewis 1927) but its history over the following 20 years is obscure. The Hudson's Bay Company promoted the collection of eiderdown along the south coast of Baffin Island from 1939 to 1942, obtaining a total of approximately 1700 kg of uncleaned down, but the operation was subsequently abandoned. Renewed encouragement from federal authorities in the mid 1950s prompted a revival, with experimental programs being established in Ungava Bay, Frobisher Bay, and Cape Dorset (Cooch 1965, Edwards 1957) and reorganization of the industry on the north shore of the Gulf of St. Lawrence (CWS files, Munro 1961). Through the 1960s the industry expanded to cover the St. Lawrence estuary and sporadic efforts were conducted in New Brunswick, southern Baffin Island, and Hudson Bay. In the 1970s a variety of circumstances, including administrative changes (and turmoil) within certain commercial enterprises, led to a situation wherein some colonies were exploited only sporadically, and record-keeping inadequately maintained; some of the progress made in the previous decade appeared to have been lost, as witnessed by the lack of harvesting in New Brunswick, Hudson Bay, and Baffin Island. In the first few years of the present decade there has been a strong resurgence of interest, prompted at least in part by increased market values of the product.

Table 1 summarizes quantities of eiderdown collected for the commercial trade in Canada over the past 3 decades. The decrease in harvest from the Gulf of St. Lawrence reflects the dramatic decline in nest numbers resulting from egging and shooting (Chapdelaine, Dupuis, *et al.*, this publication). The better protected colonies of the St. Lawrence estuary have more or less maintained their numbers, and down-collecting has intensified. The situation in arctic Canada is more difficult to appraise because of the lack of records but it appears that only the Payne Bay (Kangirsuk) area of Ungava Bay has remained active since the 1960s, having marketed unknown quantities on an annual basis in the early 1970s and sporadically since then.

5.2. Potential of the industry □

The well known situation of eider "farming" in Iceland differs in several respects from that in Canada. On the most famous of the Icelandic colonies private owners control predators, minimize disturbances, and erect nest shelters. Colonies are often located in close proximity to their owner's dwelling, and eiders have become tolerant of his or her presence (Munro 1961, Palmer 1976, Doughty 1979). Careful husbandry has allowed both the eider population and the down industry to flourish throughout the present century. The many unmanaged colonies also make a substantial contribution to the country's down harvest (J. Bédard, pers. commun.; Doughty 1979). Throughout Iceland eiders benefit from legislation and public opinion that severely limit their shooting at all times. In contrast many Canadian colonies are on Crown or public land, remote from human habitation, and frequently co-inhabited by predatory gulls. Hunting of adults and egging are common spring activities of Inuit in northern areas (Cooch, this publication; Bruemmer 1982). Recreational hunting is popular during the legal season in the Gulf of St. Lawrence, the Maritime Provinces, and Newfoundland (Wendt and Silieff, this publication) where, in the more remote regions illegal spring shooting occurs. As a result, Canadian eiders are generally less tame and more likely to fail in their breeding attempts when disturbed. Another important difference is the efficiency of harvesting down; for some Icelandic farmers all nests are within a short walking distance of home, allowing each to be harvested at the most appropriate time, whereas many Canadian down collectors must make lengthy, sometimes dangerous boat trips to the colonies, limiting their harvesting to a single visit at which time not all nests are "ripe" for harvesting. Thus most Canadian eider colonies cannot be expected to be as efficient producers of marketable eiderdown as their Icelandic counterparts, on a sustained basis.

As a first step in evaluating the potential of the eiderdown industry in Canada, I excluded large areas where small numbers of nests and their remoteness from existing communities preclude harvesting. I assumed that 50–95% of the nests in the remaining regions (Table 2) are harvestable (depending on the degree of difficulty of access), and that 120 nests will yield 1 kg of cleaned down (based on values calculated for eastern Canada: pers. obs.; J. Bédard, pers. commun; Cooch 1965). Many subjective decisions were required, particularly for arctic locations where the data were meagre and my familiarity with the local situation limited. As more data accumulate, and as harvesting costs and market values change, revisions will certainly be required.

Of a total potential yield of approximately 500 kg of cleaned down, almost a third comes from the St. Lawrence estuary. That analysis suggests that down is presently being harvested in the St. Lawrence estuary slightly beyond the hypothetical potential (Tables 1 and 2), I believe due to an underestimation of the potential rather than overharvest. The large colony on Ile Bicquette probably has a higher than average yield per nest and can be harvested twice (the only colony where such a practice is acceptable).

A large quantity is also potentially available in Ungava Bay and the adjacent Kangiqsujuaq area and could soon be harvested for the commercial trade if local interest continues to flourish (Kemp *et al.* 1982). The potential harvest of down on the east coast of Hudson Bay, including the Belcher Islands, may exceed that shown in Table 2 because the northern part of the Nastapoka Islands were excluded due to their remoteness from settlements; presently no down is harvested in this area. The potential of southern Baffin Island is significant and also probably underestimated because many nests are outside normal travel range from local settlements. Elsewhere the potential is low and being exploited only in the Gulf of St. Lawrence and (in 1982) near Grand Manan, NB.

The total Canadian potential represents about one-third of the quantity produced in Iceland (1588 kg in 1963: Palmer 1976) but exceeds that presently marketed from Greenland (ca. 100 kg: Palmer 1976). Large quantities are also produced in Norway and the USSR but recent figures are not available. Market values showed a strong upward trend through the 1970s and 1980–81 but dropped somewhat in 1982–83. With an average value for 1980–83 of approximately $450 per kg, the present market potential in eastern Canada is about $200 000 annually.

The unequalled quality of eiderdown as an insulating material (Palmer 1979) is no guaranty of the viability of the industry. Increasing demands for cold weather sport garments and sleeping bags appear to be favouring synthetic materials

Table 1
Summary of eiderdown collected for the commercial market in Canada, 1965–82
Quantités de duvet cueillies pour fins commerciales au Canada, entre 1965 et 1982

Region *Région*	Yield of cleaned down,* kg *Quantité de duvet épuré,* kg* 1965–69†	 1975	 1982
Gulf of St. Lawrence	58	5	7
St. Lawrence estuary	108	140	214
New Brunswick (Grand Manan area)	16	0	4
Northern Quebec and Labrador (mainly Ungava Bay)	174‡	?	0
Southern Baffin Island	66‡	0	0
Belcher Islands	16‡	0	0

* After cleaning by machine; this represents about 20–23% of the weight of raw down.

† Annual mean.

‡ Based on the more complete records of 1967 and 1968; in other years the records show only a total for arctic Canada which was lower in 1965–66 but higher in 1969.

* *Après le nettoyage à la machine; ceci représente environ 20 à 23 % du poids du duvet brut.*

† *Moyenne annuelle.*

‡ *D'après les registres plus complets de 1967 et 1968; pour les autres années, seul le total pour tout l'Arctique était indiqué. Ce total était substantiellement inférieur en 1965–1966, mais plus élevé en 1969.*

Table 2
Assessment of the potential harvest of eiderdown in eastern Canada
Évaluation de la cueillette potentielle de duvet dans l'est du Canada

Region *Région*	Present status of the population *État actuel de la population*	Accessibility *Facilité d'accès*	Abundance and density of nests* *Abondance et densité des nids**	Estimated number of accessible nests *Nbre estimé de nids accessibles aux chasseurs*	Approximate yield of clean down, kg *Rendement approximatif de duvet épuré, kg*
Maritime Provinces					
Grand Manan area, NB	Healthy, stable *Bon, stable*	Easy from G. Manan *Facile à partir de G. Manan*	ca. 1500 of which 1300 in mod. density on 3 islands *ca. 1500 dont 1300 en densité moyenne sur 3 îles*	1 200	10
East shore, NS	Healthy, stable *Bon, stable*	Relatively easy from various harbours *Relativement facile à partir de plusieurs ports*	ca. 2750, majority on 8 islands, mod. density *ca. 2750, majorité sur 8 îles, densité moyenne*	1 900	16
St. Lawrence Estuary	Healthy, stable *Bon, stable*	Relatively easy from various harbours *Relativement facile à partir de plusieurs ports*	ca. 18 500, most in large, dense colonies *ca. 18 500, la plupart en grosses et denses colonies*	17 500	146
Gulf of St. Lawrence	In early stage of recovery from severe decline *Premier stade de récupération d'un sérieux déclin*	Relatively difficult *Relativement difficile*	ca. 5200 of which 4000 are sparsely distributed along 100 km of coastline *ca. 5200 dont 4000 éparpillés le long de 100 km de côte*	2 500	20
Labrador					
Table Bay – Spotted Island	Healthy, possibly increasing *Bon, peut-être en expansion*	Moderately difficult *Modérément difficile*	ca. 2500, most on about 10 islands, mod. density *ca. 2500 dont la majorité sur 10 îles, densité moyenne*	1 800	15
Nain area	Apparently healthy, stable *Apparemment bon, stable*	Moderately difficult *Modérément difficile*	ca. 2500 widely scattered along 70 km of coastline *ca. 2500 éparpillés le long de 70 km de côte*	1 500	12
Northern Labrador	Healthy, stable or increasing *Bon, stable ou en expansion*	Difficult *Difficile*	ca. 1600, most on 7 islands *ca. 1600, la plupart sur 7 îles*	1 200	10
Ungava Bay					
Eider Islands	Probably stable with some slight local declines since 1950 *Probablement stable avec quelques déclins locaux depuis 1950*	Moderately difficult *Modérément difficile*	ca. 4000 on many islands, low density *ca. 4000 sur plusieurs îles, densité faible*	3 000	25
Plover, Payne Islands, Virgin Lake		Relatively easy *Relativement facile*	ca. 3500 on many islands, low and med. density *ca. 3500 sur plusieurs îles, densité faible et moyenne*	2 400	20
Gyrfalcon Islands		Moderately difficult *Modérément difficile*	ca. 3500 on many islands, low density *ca. 3500 sur plusieurs îles, densité faible*	2 000	17
East coast		Difficult *Difficile*	ca. 6500 scattered in small sparse colonies *ca. 6500 éparpillés en petites colonies, densité faible*	4 000	33

(cont'd)

Table 2 (cont'd)

Region *Région*	Present status of the population *État actuel de la population*	Accessibility *Facilité d'accès*	Abundance and density of nests* *Abondance et densité des nids**	Estimated number of accessible nests *N^{bre} estimé de nids accessibles aux chasseurs*	Approximate yield of clean down, kg *Rendement approximatif de duvet épuré, kg*
Hudson Strait					
Que. – Maricourt and Sugluk	Probably stable with some slight local declines since 1950 *Probablement stable avec déclins locaux depuis 1950*	Moderately difficult *Modérément difficile*	ca. 7500 scattered in small sparse colonies *ca. 7500 éparpillés en petites colonies, densité faible*	6 000	50
Baffin – Cape Dorset, W. Foxe Islands	Severe decline since 1956 *Déclin important depuis 1956*	Relatively easy from Cape Dorset *Relativement facile à partir de Cape Dorset*	ca. 3000 mostly in small scattered colonies *ca. 3000 éparpillés en petites colonies, densité faible*	2 000	17
Baffin – Savage Islands	Probably some local declines *Probablement quelques déclins locaux*	Difficult from Lake Harbour *Difficile à partir de Lake Harbour*	A few thousands in small, scattered colonies *Quelques milliers éparpillés en petites colonies, densité faible*	2 000(?)	17(?)
Cumberland Sound					
Pangnirtung	Probable decline in recent decades *Déclin probable depuis quelques décennies*	Relatively easy (?) *Relativement facile (?)*	ca. 1500 in small scattered colonies *ca. 1500 éparpillés en petites colonies*	1 000	8
Southampton Island	Unknown *Inconnu*	Relatively difficult *Relativement difficile*	ca. 4000 in one dense colony *ca. 4000 dans une colonie dense*	2 000(?)	17(?)
Hudson Bay – e. coast					
Akulivik, Inukjuak, Great Whale, Povungnituk	Probable slight overall decline since 1950 *Léger déclin probable depuis 1950*	Moderately difficult in general *En général, modérément difficile*	ca. 13 000 within reach of settlements in small scattered colonies *ca. 13 000 près des communautés, surtout en petites colonies*	7 800	65
Belcher Islands	Unknown *Inconnu*	Relatively easy (?) *Relativement facile (?)*	ca. 1500 widely scattered in small colonies *ca. 1500 éparpillés en petites colonies*	1 000	8
Total					506

* Does not include nests judged to be beyond normal travel range from local settlements: extracted from CWS files and articles in this publication authored by Erskine and Smith; Lock; Gaston and Cooch; Abraham and Finney; Chapdelaine, Dupuis, *et al.*; Chapdelaine, Bourget, *et al.*.

* *N'inclut pas de nids jugés trop éloignés des communautés: extrait des dossiers du SCF et d'articles dans la présente publication signés par Erskine et Smith; Lock; Gaston et Cooch; Abraham et Finney; Chapdelaine, Dupuis et al.; Chapdelaine, Bourget et al.*

Table 3

Nest success of Common Eiders on the Northeast Rasade Island in relation to down harvesting, 1965

Succès de la nidification de l'Eider à duvet sur l'île Rasade Nord-Est, en relation avec la cueillette de duvet, 1965

			Nest losses, % *Perte de nids, %*			
	Quadrant	Number of nests *Nombre de nids*	Within 5 days *En dedans de 5 jours*		By end of season *Avant la fin de la saison*	
Down collected *Duvet cueilli*	N	11	45	58	82	79
	S	56	61		79	
Down not collected *Duvet non cueilli*	E	65	42	45	65	67
	W	20	55		75	

which, unlike down, maintain their insulating qualities when wet. Down and chopped feathers from domestic waterfowl dominate the down market because they are consistently available in larger and cheaper supply. In Europe, however, a traditional recognition of the superior quality of genuine eiderdown for both outdoor gear and for coverlets or comforters, ensures some stability to the market. For the success of the Canadian industry it seems imperative that our eiderdown capture a consistent and profitable portion of the European market, or that the raw material and finished products be successfully promoted on the North American scene.

5.3. Does eiderdown collection affect duckling production? □

The Icelandic situation has frequently been cited as proof that eider populations can be maintained, even increased, under a harvesting regime. However the process of down collection involves two actions, the disturbance of nesting birds and removal of part of the nest down, the consequences of which vary according to local situations. The disturbance factor is minimized in many Iceland colonies because of the tameness of the birds, the absence of predators, and other factors. Such tameness and paucity of predators is not encountered in Canadian colonies, although the reduced wildness of eiders on Ile Bicquette (pers. obs.), where careful protection has been ensured by resident lighthouse keepers for several decades (Bruemmer 1979), suggests that an Icelandic-type situation could eventually be

Table 4
Number of eiders killed and eggs collected by Inuit hunters from various communities in the eastern Canadian Arctic
Nombre d'eiders abattus et d'oeufs ramassés par des chasseurs inuit de différentes communautés de l'est de l'Arctique canadien

		Number of eiders killed *Nombre d'eiders abattus*						Number of eggs (June–July) *N^bre d'oeufs (juin–juil.)*
		April	May	June	July	Total Apr.–July	Total 12 months *12 mois*	
Ungava Bay and south coast Hudson Strait								
Kangiqsualujjuaq	*	0	3	133	192	328	463	2646
Kuujjuaq	*	0	22	169	99	290	424	1745
Tasiujaq	*	0	1	252	66	319	390	1331
Aupaluk	*	2	3	39	45	89	317	1469
Kangirsuk	*	0	0	30	52	82	126	605
Quaqtaq	*	0	6	32	10	48	240	776
Kangirsujuaq	*	0	55	133	205	393	568	3294
Salluit	*	0	7	45	89	141	758	955
East coast, Hudson Bay								
Akulivik	*	14	82	217	104	417	943	2082
Inukjuak	*	125	613	1155	574	2467	4468	3439
Kuujuarapik	*	3	27	131	147	308	1432	1626
Belcher Islands	†	5	389	633	724	1751	6000	6400
Baffin Island								
Cape Dorset	†	392	548	877	932	2749	3470	>5000
Lake Harbour	†	2	26	115	165	308	760	>7000
Frobisher Bay	†	0	9	25	27	61	370	Unknown (small) *Inconnu (petit)*
Pangnirtung	†	2	5	508	266	781	2300	Unknown (large) *Inconnu (grand)*
Broughton Island	†	0	15	29	55	99	356	250–300
Clyde River	†	0	30	27	7	64	301	15–20
Pond Inlet	†	0	2	2	5	9	26	20–40
Arctic Bay and Nanisivik	†	0	0	19	5	24	194	Unknown (small) *Inconnu (petit)*
Foxe Basin								
Igloolik and Hall Beach	†	0	6	192	52	250	510	2500–3500
High arctic islands								
Resolute Bay	†	0	0	0	37	37	53	20–30
Grise Fiord	†	0	7	26	55	88	281	200–300

* Estimated harvests are derived from James Bay and Northern Quebec Native Harvesting Research Committee (1980, 1982*a*, *b*) and L. Brooke (pers. commun.), and represent means (eiders 1979–80, eggs 1976–80). A small proportion of the eggs may be of other duck species.

† Estimated harvests are from preliminary results of Baffin Region Inuit Association Harvest Study (J. Donaldson, pers. commun.) for 1982.

* *Les estimations de prises proviennent du «Comité sur la recherche des prises par les autochtones du Nord québécois et de la Baie James» (1980, 1982a, b, et L. Brooke, comm. pers.), et représentent des moyennes (eiders, 1979–1980; oeufs, 1976–1980). Une faible proportion des oeufs peuvent provenir d'autres espèces de canards.*

† *Les estimations des prises proviennent des résultats préliminaires d'une enquête menée par l'«Association des Inuit de l'île de Baffin» (J. Donaldson, comm. pers.) en 1982.*

achieved. The principal consequence of disturbance to nesting eiders is increased nest losses through abandonment and egg predation.

The removal of nest down can also increase heat lost from unattended eggs and from incubating females and hamper the concealment of eggs during nest absences. Thus there are three components of nest losses: natural losses (those that would occur in the absence of human disturbance), losses caused by disturbance by the collector, and those caused by removal of down.

A pilot experiment was conducted on the Northeast Rasade Island in the St. Lawrence estuary during 1965 to appraise the effects of down collection on nest success. The small grassy island was divided into four quadrants, and on an initial visit, when most nests were in mid to late incubation, nests were located and recorded throughout the island. At the same time down was collected from those nests containing sufficient quantities in two of the opposing quadrants, but not in the other two. In all cases the eggs were carefully covered with the remaining nest down after examination. I checked the nests at approximately weekly intervals until I knew their fate. Both harvested and unharvested nests suffered high losses, presumably as a result of disturbance, which is particularly devastating in dense colonies in which gulls are abundant and nesting cover low. Nests in the unharvested quadrants had a higher survival rate (Table 3), both in the 5 days following down collection ($Z = 1.58$; $P = 88\%$: test of difference in proportions, Dixon and Massey 1969) and over the full season ($Z = 1.62$; $P = 90\%$). Those results suggest that removing nest down caused an additional loss of about 12% over the already high losses attributable to the disturbance caused by the investigator–collector. Unfortunately the data do not permit calculation of the success rate which might have been achieved in the absence of down-collecting activities. Most losses were recorded as having resulted from predation but many of the nests might have been abandoned prior to being attacked by predators. Thus it is inappropriate to attempt to break down nest losses by causes, except to indicate that almost all were apparently due to either predation by gulls or nest abandonment.

The tentative conclusions drawn from the Northeast Rasade experiment do not apply to other colonies where predator abundance, nesting cover, climate, and other factors are different. It would be useful to conduct similar experiments in a variety of situations.

For centuries Inuit have eaten eiders and their eggs. In spring and summer they offer a welcome change from a winter diet of seal and caribou. Today, in some settlements, a few families make extensive excursions to gather eggs and share them in the community.
Depuis des siècles, les Inuit prennent des eiders et leurs oeufs pour fins de subsistance. Cette forme de nourriture est particulièrement appréciée au printemps et en été, alors qu'elle offre un changement à leur régime hivernal dominé par la viande de phoque et de caribou. Aujourd'hui, dans certains villages, quelques familles se spécialisent dans la cueillette d'oeufs, entreprenant de longues excursions afin de ramasser des oeufs pour être partagés avec d'autres familles du village.
(photo: F. Bruemmer)

6. Collecting eggs and shooting breeding adults

The signing of the Migratory Bird Convention (1916) and the enabling Canadian act (1917) rendered the taking of eiders and their eggs illegal at all seasons for a period of 5 years; since then a hunting season has been established which can extend between 1 September and 10 March. These restrictions have been applied less vigorously, or not at all, in certain aboriginal native communities in recognition of subsistence needs, or because of apparent contradictions with other legislation, or for logistic reasons. In practice the taking of eggs and adults during the breeding season has been drastically reduced or totally eliminated in southern Canada, except for a few remote localities along the north shore of the Gulf of St. Lawrence and in Newfoundland and southern Labrador. In northern Canada those activities are now restricted to certain Inuit communities; the importance of their take is only becoming known as special harvest surveys are being set up. The results, preliminary as they may be, cover most of the important areas of the range.

The largest kill of adults occurred on the east coast of Hudson Bay, the Belcher Islands, Cape Dorset, and Pangnirtung (Table 4). The same areas are also subjected to large harvests of eggs as are the regions of Kangiqsujuaq and Kangiqsualujjuaq (Ungava Bay).

The major part of that harvest is used for food. During the breeding season 17.7 metric tons of meat and approximately 4.3 metric tons of eggs are harvested by residents of the communities listed in Table 4 (calculated from weights provided in Bellrose 1980; Lack 1968; Prach *et al.*, this publication; and edible proportions given in reports of the James Bay and Northern Quebec Native Harvesting Research Committee, 1976). During the other eight months an additional 19.4 metric tons of meat are harvested. For the communities of northern Quebec the food provided by eiders accounted for approximately 1.5% of the total wild food consumed annually, being most important in the Hudson Bay communities of Inukjuak, Akulivik, and Kuujjuarapik where the percentage varied from 2 to 3%. A study conducted in Lake Harbour in the 1960s (Kemp 1971) indicated a somewhat greater importance of eiders in the annual consumption of wild foods. Also of importance is the diversity which eiders and their eggs add to a diet derived principally from sea mammals and caribou. In some settlements the skins and feathers of shot eiders are used to make garments and pillows.

No data are available to compare present-day harvests with those of the past but three factors have had strong influences on native harvesting practices: the advent of firearms, increased mobility of hunters (snowmobiles, outboard motors), and polarization of activities around settlements. Certainly firearms rendered the taking of eiders much easier and it appears highly unlikely that harvests as large as those taken today could have occurred with the weapons (arrows, spears, snares, and bolas) previously available. Although present-day hunters can travel much more rapidly, and over greater distances, not all of that advantage is used to cover a larger hunting range, some preferring to utilize it to return more frequently to their home settlement. The combined effect of mobility and village-oriented life varies from community to community. Cooch (this publication) described the situation near Cape Dorset where increased local activity and improved means of transportation have led to intensive egging and shooting of eiders. In the Middle Savage Islands hunting eiders and taking their eggs has been facilitated by modern technology but fewer families participate, due to the extended travel from Lake Harbour required (Bruemmer 1982). Closing down the Killiniq settlement in the mid 1970s reduced exploitation of northern Labrador and northeastern Ungava Bay colonies. Unfortunately no broad generalization can be drawn from these cases, beyond speculating that large harvests have probably occurred for well over a century and that exploitation has recently intensified in certain local areas. In previous centuries, especially during the heyday of arctic whaling, egging may have reached even greater proportions near good anchorages, as the crews of sailing vessels often relied on local foods for survival.

7. Other uses of eiders during the breeding season

In urbanized areas of southern Canada there has been a strong upsurge in demand for opportunities to view wildlife in its natural setting. Specialized travel agencies now offer a wide variety of wildlife-oriented tours, the destinations and price tags of which testify to the importance of the demand. Most people seek such activity close to home or in conjunction with annual vacation. Breeding eiders have much to offer those seeking enjoyment, understanding, and inspiration in wildlife observation. Febrile activity, intriguing postures, striking coloration, and strange vocalizations characterize eider colonies. The tranquility and camouflage of incubating females, the rising and falling of fluffy rafts of ducklings in the ocean swell are but two examples of the types of scene likely to leave indelible impressions with the viewing public. Such attractions are available within easy travelling distance of Quebec City, Halifax, Fredericton, Saint John, Rivière du Loup, and Rimouski, or near major tourist routes or important meccas for natural history enthusiasts (Ile-aux-Basques, Grand Manan, and the Auyuituq National Park on Baffin Island). The expected recovery of eider populations of the north shore of the Gulf of St. Lawrence (Chapdelaine, Dupuis, *et al.*, this publication) will add a valuable element of attraction to the Mingan National Park presently under development.

At present the activity is enjoyed by relatively few people, partially due to ignorance of the potential, partially to the lack of facilities. Many of those who presently do so are ignorant of the fact that heavy losses of eggs and chicks can occur as a result of disturbance. Expansion would require promotion, the development of certain facilities and, most importantly, careful control and surveillance. Due to the harmful effects of human disturbance, visits to nesting colonies will rarely be advisable, but perhaps a few situations could be found in which specially constructed blinds could allow small groups under close supervision to gain intimate contact with nesting birds. Guidelines or regulations will also have to be established to prevent disturbance of broods and crèches.

Other uses include professional photography and scientific research. Within the past two decades the eider population of the St. Lawrence estuary has been under continual study by researchers who have produced more than 14 scientific papers and five graduate theses, which attests to the value of the species as a research subject.

8. Conclusions

Certain examples have been described in this study which support the premise, so elegantly illustrated by the centuries old Icelandic experience, that with careful management breeding eiders can provide a wealth of benefits to humans. Other examples show how uncontrolled or careless exploitation has resulted in drastic and long-term population declines. There is no biological evidence to suggest that any of the forms of use described should be totally banned nor given "carte blanche." Each must be judged in relation to the full range of factors acting on the population, and a choice of uses, and a level of each, determined with the ultimate goal of maintaining a thriving eider population while optimizing benefits to our own species.

One form of exploitation, the shooting of breeding adults, is most likely to lead to population decline. That was recognized in the Migratory Bird Convention, and prohibition has been justifiably enforced throughout the densely populated portion of Canada. The case of native subsistence hunters in the north, where strong cultural traditions and subsistence needs are evident, requires special consideration; some level of harvesting of adults would be biologically acceptable, providing other forms of loss were small enough to allow population balance. But Cooch (this publication) has computed that each adult female shot has as much impact on population balance as the taking of 29 eggs; since one adult female (*S.m. borealis*) provides about 1.2 kg of edible meat and 29 eggs, 2.7 kg of food, the subsistence hunter would gain more food (and probably at less cost) by harvesting eggs. The combined harvest of eggs and adults is high in many northern communities, producing some discernible local declines (Cooch, this publication). An eventual intensification of eiderdown collection in arctic colonies will add more stress to these populations. Difficult decisions lie ahead in the management of northern populations of eiders.

In southern Canada, with egging and spring shooting eliminated in most areas, the chief consideration is the effect of disturbance wrought on nesting eiders by boaters, naturalists, researchers, and down collectors. In the St. Lawrence estuary many of those forms of disturbance have increased in the past decade, making it urgent to update the recent evaluation of population status (Chapdelaine, Dupuis, *et al.*, this publication) which generally covered the period up to 1976–78. It appears inevitable that all these forms of disturbance will have to be more effectively controlled in the near future. At present only down collecting is controlled on private and public land, through the issuance of special permits by the Canadian Wildlife Service (CWS). New forms of control will have to be sought in respect to other forms of disturbance, especially on lands not under the custodianship of CWS. Presently only the down collectors are organized to apply for authorization to visit the colonies and could theoretically lay claim to all before other potential users express their requirements. Subsequent cutbacks to down-collecting claims in order to accommodate other users are likely to be highly unpopular with that competitive commercial industry. It is important to establish long-term policy regarding the various uses to which the resource will be subjected.

An exciting endeavour, the progress of which will be followed with great interest, is the recent establishment of a non-profit company to invest the benefits from down sales into various forms of wildlife and wildlife habitat conservation.

Of special concern is the poaching and egging that continues on the north shore of the Gulf of St. Lawrence. Recent efforts at prevention and law enforcement must be intensified so that populations may recover to former levels of abundance.

Few wildlife species offer such an array of potential benefits. Additional data are required to properly weigh the various parameters involved, but selecting those blends of uses that optimize benefits and ensure flourishing populations promises to be a challenging and rewarding exercise for wildlife managers over the coming decades.

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The kill of eiders and other sea ducks by hunters in eastern Canada

Le nombre d'eiders et autres canards de mer abattus par les chasseurs dans l'est du Canada

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E. Silieff

1. Abstract

The harvest of Common Eiders, Oldsquaw, Black Scoters, Surf Scoters, and White-winged Scoters by hunters in eastern Canada holding Migratory Game Bird Hunting Permits is examined. The results of the national survey of hunters are used to show the distribution of eider kill, and trends in the size of harvest for each species from 1974–75 to 1982–83. The results of a special survey conducted in Newfoundland confirmed that the national survey estimates of the size of the kill there are incomplete: the national survey indicated harvests of 16 500 to 24 200 sea ducks in Newfoundland in 1977–79, but the special survey suggested a kill of over 100 000. The bias, due to variable response rates as well as to termination of the national survey before the close of sea-duck hunting in Newfoundland in March, is less important in other areas of eastern Canada. An improved survey design was introduced in 1983–84 which is expected to provide better estimates of the kill of sea ducks in Newfoundland.

2. Résumé

Les prises d'Eiders à duvet, de Canards kakawis, de Macreuses à bec jaune, de Macreuses à front blanc et de Macreuses à ailes blanches par des chasseurs de l'est du Canada qui possèdent un permis de chasse aux oiseaux migrateurs sont examinées. Les résultats de l'Enquête nationale sur les prises ont permis d'illustrer la distribution des prises et d'examiner les tendances dans les tableaux de chasse pour les principales espèces, de 1974–1975 à 1982–1983. Les résultats d'une enquête spéciale menée à Terre-Neuve démontrent des biais importants des estimations de la taille des prises telles qu'établies par l'enquête nationale. À titre d'exemple, l'enquête nationale indiquait des tableaux de chasse pour les canards de mer à Terre-Neuve variant entre 16 500 et 24 200 durant la période de 1977 à 1979; l'enquête spéciale suggérait un nombre de prises supérieur à 100 000. Cette erreur, attribuable à un faible taux de réponse et au fait que l'enquête nationale s'est terminée avant la fermeture de la saison de chasse à Terre-Neuve en mars, est de moindre importance ailleurs dans l'est du Canada. L'enquête a été améliorée en 1983–1984, ce qui devrait aider à fournir de meilleures estimations du nombre de prises de canards de mer à Terre-Neuve.

3. ᓄᐃᑎᑕᐅᔪᑦ

ᒥᑎᕐᓂᐊᑕᐅᓂᖏᑦ. Oldsquaw. Black Scoters. Surf Scoters. ᐊᒻᒪᓗ Whitewings Scoters ᒪᑯᓇᖕ ᐆᒪᔪᕐᓂᐊᑎᓄᑦ ᒫᓂ ᑕᕐᕋᖕᓂ ᑲᓇᑕᐅᑉ ᓇᔪᕐᑎᕆᓐᓄᑦ ᐊᐅᓚᓯᑦ ᒥᑮᑦ ᐆᒪᔪᕐᓂᐊᕈᑎᒥᑦᓯᒥᑦ ᖃᐅᔨᓴᕐᑕᐅᒪᔪᑦ. ᐱᔭᓐᕐᑕᐅᒪᓕᕐᑎᓗᒍ ᖃᐅᔨᓴᕐᓂᖅ ᑕᒪᓂᓕᒪᖅ ᓄᓇᓕᒫᒥ ᖃᐅᔨᓴᕐᑕᐅᓂᖓᓄᑦ ᐅᒪᔪᕐᓂᐊᑎᑦ ᐊᑐᓂ ᐅᒪᔪᓄᑦ ᐱᒥᐊᕐᓯᓂ 1974-75-ᒥ 1982-83-ᒧᑦ ᑎᑭᑦᓯᓂ. ᖃᐅᔨᓴᕐᑕᐅᒪᓂᖏᓐᓗ ᑕᐃᒪᑐᐃᓐᓇᐅᖏᑦᑐ ᖃᐅᔨᓴᕐᑕᓄᑦ ᓂᐅᐸᐅᓛᓐᒥ ᓇᓗᓇᐃᕐᓯᔪᖅ ᑖᓐᓇ ᓄᓇᓕᒫᕐᑯᑦ ᖃᐅᔨᓴᕐᓂᐅᓯᒪᔪᖅ ᑕᐃᓯᒪᒻᒪᑦ ᒥᑎᕐᓂᐊᑕᐅᓯᒪᓂᖏᓐᓂᒃ 16,500-ᒥᑦ 24,200 ᒥᑮᑦ 1977-79-ᒥ. ᑭᓯᐊᓂ ᑕᐃᒪᑐᐃᓐᓇᐅᖏᑦᑐᖅ ᖃᐅᔨᓴᕐᓂᖅ ᐃᓯᒪᖄᕐᐳᖅ ᑕᒃᑯᓇᖕᑦ ᑐᖕᑕᐅᒪᔪᓂᑦ ᒪᕐᕉᓐᓗᐊᕆᐊᖏᑦ ᑐᖕᑕᐱᓂᐅᒥᐊᖏᑦ. ᐱᑦᔪᑎᒥᓯᒪᓐᓚᑦᑕᖕ ᑕᒪᑐᒪ. ᒫᓐᓇ ᐱᑦᔪᑎᒥᑦᓯᒍ ᐃᑭᒃᑐᓯᑎᒃ ᑭᓯᑕᐅᒪᓂᖏᓐᓄᑦ ᑕᑯᐊᓚᓴᐃᑦ ᓄᖃᓯᒪᓂᖕ ᓄᓇᓕᒫᕐᑯᑦ ᖃᐅᔨᓴᕐᓂᐅᓯᒪᔪᖅ ᐱᔭᓐᖑᐅᕐᑎᓇᒍ Newfoundland ᐃᒪᖕᑕ ᒥᑎᖏᑦᑕ ᒥᑎᕐᓂᐊᑕᐅᒪᓂᖏᓐᓄᑦ ᒪᑦᓴᒥ. ᐱᑦᔪᑕᐅᐱᖕᓗᓐᓗᐊᕆᐊᖃᖏᓪᓗᒃ ᒪᑐᒪ ᓴᓂᐊᓂᑦ ᑲᓇᑕᐅᑉ ᓯᕿᓂᖕᑕ ᐊᕿᒥᐊᑦᓯᐊᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᓂᓴᐅᓕᕈᕐᑐᑦ ᐃᒪᕐᒥᐅᑕᓂ ᒥᑎᕐᓂ ᐱᒥᐊᓚᕈᓇᐅᐸᑦ 1983-84-ᒥ.

4. Introduction

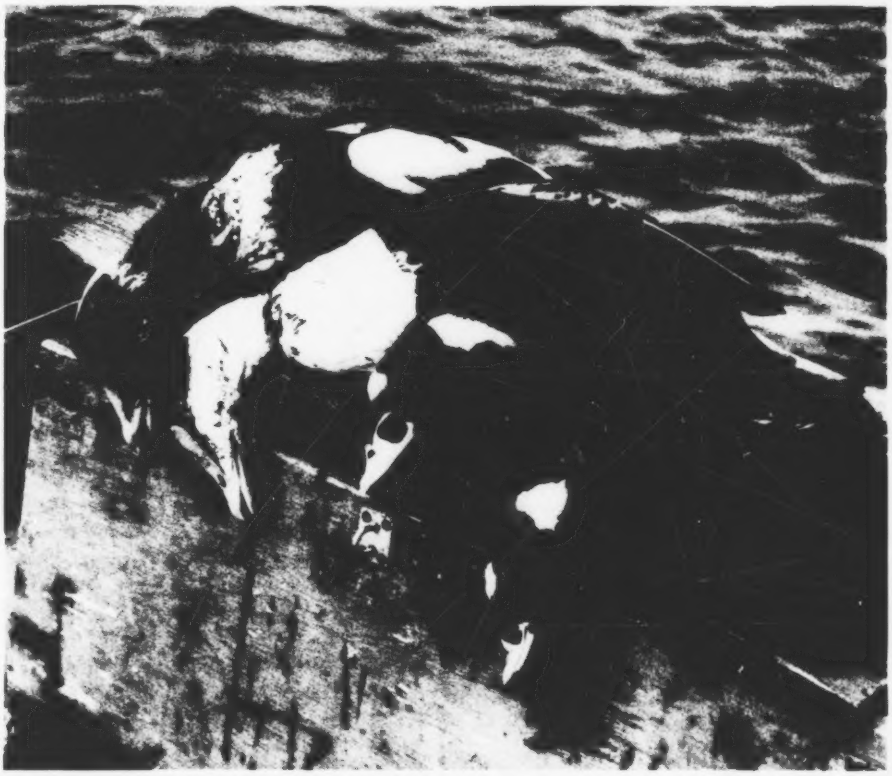
Hunting is an activity that produces important economic and social benefits throughout most of North America. Although dabbling ducks (tribe *Anatini*) and scaup (*Aythyini*) are the ducks most generally sought after, five species of sea ducks (the Common Eider, *Somateria mollissima*: Black, Surf, and White-winged Scoters, *Melanitta nigra*, *M. perspicillata* and *M. fusca*; and Oldsquaw, *Clangula hyemalis*) are taken in appreciable numbers and are the main quarry of many hunters inhabiting coastal areas, the shores of the Great Lakes, and other large water bodies in eastern Canada. Two other sea ducks, the King Eider (*Somateria spectabilis*) and the Harlequin Duck (*Histrionicus histrionicus*), are taken in small numbers.

Most approaches to waterfowl population management start with a conceptual model relating breeding stocks, production, and mortality. This heuristic model cannot be made rigorous for most species, because of limitations in available data. It is particularly difficult to determine population sizes for most sea ducks. During the breeding season most species nest inconspicuously over large tracts of inaccessible terrain, (an exception being the Common Eider, which often nests in colonies, making partial censuses feasible). Most species stage or overwinter in dense flocks on large bodies of water, making wintering population estimates almost as difficult to obtain (Gillespie and Learning 1974). The determination of mortality and/or harvest rates by band return analysis is also impractical because so few sea ducks have been banded in North America and of these few have been recovered. Mortality estimates have been derived for the St. Lawrence estuary Common Eider population (Reed 1975) and for a colony of White-winged Scoters in Saskatchewan (Brown and Houston 1982), but these analyses are isolated exceptions.

The Canadian national surveys of hunters provide estimates of kill by species, but the usefulness of the survey results as absolute measures of hunting kill is lessened by various biases inherent in the surveys (see next section) and because reliable estimates of the size of the stocks from which the kill is taken are not available. Ideally such counts would be required on a periodic basis for monitoring purposes. Nevertheless the survey results are advantageous because of the broad sampling frame on which they are based. In this paper we confirm, through comparison with a special survey conducted in Newfoundland, that serious biases exist in the estimation of the kill of sea ducks, especially in Newfoundland. We present results on kill location and trends in the kill that we believe are genuine, and summarize the results from the national survey for 1974–82.

The national surveys are based on a sampling frame made up of purchasers of migratory game bird hunting permits. Some aboriginal Canadians are not required to purchase the permit. In some northern communities a significant portion of hunters do not purchase permits, regardless of their ancestry (Frank Phillips, pers. commun.). The take of sea ducks by hunters without permits is not included in the estimates that are reported and discussed in this paper. The numbers of birds crippled but not recovered by hunters are not estimated either.

Sea ducks killed by a hunter in the St. Lawrence estuary: two male Common Eiders and two male Surf Scoters
Les prises d'un chasseur de canards de mer dans l'estuaire du Saint-Laurent : deux Eiders à duvet mâles et deux Macreuses à front blanc mâles
(photo: A. Reed)



5. Methods

5.1. The national surveys □

Estimates of the kill of ducks by licensed hunters in Canada are made by means of two mail surveys. The national harvest survey (NHS) is a questionnaire survey used to establish the overall number of ducks killed. The species composition survey (SCS) is a collection of duck wings that is used to divide the NHS estimate of total duck kill among the constituent species. For a full description of methods, see Cooch *et al.* (1978).

Biases are inevitable in surveys, such as the present one, which rely on information provided from memory on a voluntary basis. Sea ducks present special problems regarding the estimation and interpretation of results.

1. Sea-duck hunters are relatively few in number, giving small sample sizes.
2. Several important sea-duck areas, especially in Newfoundland and Labrador, are also areas with low rates of response to the surveys.
3. The kill of sea ducks is much less uniform than that of other ducks, being clustered geographically and highly variable numerically.
4. Most of the sea-duck kill in some areas occurs in January–March, precluding good response to the existing national surveys, which are geared to activity in areas where waterfowl hunting ends in November or early December.
5. Sea-duck kill often occurs in remote areas where the enforcement of hunting regulations is difficult, which may lead to an increased proportion of hunters without permits, or to an increased error due to the reluctance of hunters to report illegally large bags.
6. Some hunters consider sea ducks as a group apart from the traditional "sport ducks," which they perceive erroneously as the sole subject of the survey, and so fail to report their kill of sea ducks. This confusion may stem in part from the timing of the survey, referred to in 4, above.

Recognizing the difficulty in measuring biases introduced by these problems, we have emphasized geographical distribution and year-to-year numerical trends in harvest, rather than absolute estimates. Age–ratio data, also available from the SCS, might be useful, but the interpretation of these is complex, and is not dealt with here.

In most of Canada, waterfowl hunting seasons do not extend beyond December, because nearly all inland ducks have emigrated by then, though large numbers of sea ducks overwinter in Canadian waters. In coastal districts of Newfoundland and Labrador there is a special sea-duck season extending from October or November to March 10, the latest possible date for an open season under the terms of the Migratory Birds Convention. In Nova Scotia the local sea-duck seasons extend to mid- or late January. In southern New Brunswick there is a special sea-duck season in February. In Quebec the sea-duck season on the north shore of the Gulf of St. Lawrence and on the Magdalen Islands closes in mid-February. There are no late sea-duck seasons in Prince Edward Island or in Ontario.

5.2. Sea-duck kill analyses from national surveys □

Sea-duck kill for eastern Canada was calculated using the 12 sample zones from Newfoundland to Ontario as defined in the national surveys (Cooch *et al.* 1978). So few sea ducks are killed in western Canada that they are omitted from further consideration here. The results were combined and graphed, with their standard errors (see Figs. 2–7).

5.3. A special survey in Newfoundland □

A survey used specifically to question Newfoundland hunters during the three hunting seasons 1977–78 to 1979–80, requested murre (*Uria* spp.) and sea-duck kill data for the months of September to March. (The national surveys are run from September to January and do not ask for information on the kill of murres, which may be hunted, by non-indigenous people, only in Newfoundland and Labrador.)

This was a mail survey, similar in principle to the NHS. In the first and second years samples were selected from 13 geographical strata with sampling ratios proportional to population size. The sampling was improved in the third year by using optimal allocation of the sample (Cochran 1963), according to results obtained in the first 2 years. Details of procedure are described in a report on the murre kill by Wendt and Cooch (1984).

The survey questionnaire was illustrated with a picture of a male Common Eider in flight. Common and local names were provided for the sea-duck species involved and the hunter was expected to report kill for these species only, though without being asked which species were taken.

Table 1
Estimated kill of five species of sea ducks in Newfoundland, as determined by the national harvest surveys and the special survey, 1977–78 to 1979–80
Nombres estimatifs de canards de mer abattus à Terre-Neuve, d'après l'enquête nationale et l'enquête spéciale, de 1977–1978 à 1979–1980

Survey *Enquête*	Species *Espèce*	Estimated kill in Newfoundland *N^{bres} estimatifs de prises à Terre-Neuve* 1977–78	1978–79	1979–80
National survey *Enquête nationale*	Common Eider *Eider à duvet*	15 710	14 565	12 668
	Oldsquaw *Canard kakawi*	666	0	0
	Black Scoter *Macreuse à bec jaune*	6 465	395	1 862
	White-winged Scoter *Macreuse à ailes blanches*	0	514	1 202
	Surf Scoter *Macreuse à front blanc*	1 373	739	808
	Total sea ducks *Total canards de mer*	24 214	16 213	16 540
Special Newfoundland survey *Enquête spéciale de Terre-Neuve*	Total sea ducks *Total canards de mer*	114 767	114 486	100 673

Table 2
Estimates of the kill of sea ducks in Newfoundland by month, 1977–78 to 1979–80, as determined by the special survey
Nombres estimatifs de canards de mer abattus à Terre-Neuve, par mois, de 1977–1978 à 1979–1980, d'après l'enquête spéciale

	1977–78		1978–79		1979–80	
Month *Mois*	Kill *Prises*	SE ET*	Kill *Prises*	SE ET	Kill *Prises*	SE ET
Sept.	11 616	1780	7 883	1 157	6 631	1 282
Oct.	15 474	1722	17 176	2 455	11 900	2 053
Nov.	17 357	1919	14 002	2 149	13 788	2 134
Dec.	17 835	2571	19 559	2 651	20 342	2 475
Total Sept.–Dec.	62 282		58 620		52 661	
Jan.	18 964	2359	20 374	2 993	16 139	2 245
Feb.	19 230	2404	21 673	2 985	17 178	2 827
Mar.	14 291	2397	13 819	2 358	14 695	2 609
Total Jan.–Mar.	52 485		55 866		48 012	
Total	114 767	8834	114 486	10 692	100 673	10 028

* *Erreur type.*

6. Results

6.1. Comparison of national surveys and special Newfoundland survey □

The special Newfoundland survey produced yearly kill estimates much larger than the corresponding national survey estimates (Table 1), the former averaging about 110 000 and the latter 19 000 over 3 years.

Nearly half of the discrepancy can be attributed to the large kill during January, February, and March reported in the special survey (Table 2), but missed by the national surveys. The special survey also reported substantially larger harvests for the period in which it overlapped with the national surveys; in 1977–78, for example, the special survey indicated a kill of 44 450 sea ducks from September to November, the national surveys only 24 200. We suspect that some respondents to the national survey under-reported sea ducks to the wing collection survey (SCS), considering them as non-target species of the survey. Less important, in our view, is the opposing possibility that the special survey respondents inflated their reported kill by erroneously including Goldeneye (*Bucephala clangula* and *B. islandica*), Black Ducks (*Anas rubripes*), Mergansers (*Mergus merganser* and *M. serrator*), or other species found on the coast but not classed as sea ducks.

The NHS and SCS do not provide good estimates of the absolute level of kill of sea ducks. The magnitude of error attributable to their incomplete temporal coverage of the sea-duck seasons can be estimated using the large, late-season kill revealed by the special survey. Correction factors for other biases cannot be established without additional special studies.

Because the NHS mail survey estimates of sea-duck kill are incomplete and biased, we recommend, as a rule of thumb, that the magnitude of sea-duck kill indicated by the national surveys be multiplied by factors of 2–4 for Newfoundland and 1–2 in Nova Scotia, New Brunswick, and western Quebec to obtain orders of magnitude for the total kill in each province. This acknowledges that Newfoundland has the most extreme season dates, most scattered distribution of kill, and most variable response rates among the sea-duck kill areas sampled by the national surveys. These correction factors are purposely vague; in the face of biases of unknown magnitude, we can at present do no better. The best approach is to concentrate on analysis that is acceptable despite unknown bias, such as trend analysis and geographical comparisons within strata. Some such analyses are presented in later sections.

6.2. Sea-duck kill by species

6.2.1. Common Eider (Figs. 1 and 2, Table 3) □

Part I of this publication provides comprehensive evaluations of the breeding numbers of the various races of this abundant coastal species throughout Canada. The American (*S.m. dresseri*) and northern (*S.m. borealis*) races form the vast majority of the Common Eiders available to most hunters in eastern Canada but the contribution of each to the total harvest is only partially understood (see Reed and Erskine, this publication). No attempt has been made as yet to separate races of Common Eider in the SCS, although this may be possible.

Table 3
National harvest survey estimates of the retrieved kill of Common Eiders in eastern Canada, 1974–75 to 1982–83*. Not adjusted for missing information for January–March
Nombres estimatifs d'Eiders à duvet abattus et récupérés dans l'est du Canada, d'après l'Enquête nationale sur les prises, de 1974–1975 à 1982–1983. Aucune correction n'a été apportée pour l'absence de données de janvier à mars*

	Newfoundland					Quebec	
Season *Saison*	Island *Île*	Labrador	P.E.I.	N.S.	N.B.	Gulf *Golfe*	Estuary *Estuaire*
1974	2 533	2031	51	6 382	673	2653	2139
1975	4 621	464	232	8 880	118	6796	1105
1976	9 733	4698	45	9 132	536	7585	1737
1977	10 082	5628	67	10 596	1 402	4211	1943
1978	9 846	4719	45	7 802	448	5709	2093
1979	11 205	1463	0	6 315	244	4762	506
1980	6 545	2562	61	7 930	399	6156	686
1981	2 612	0	0	11 211	415	6469	2961
1982	9 970	2236	0	6 349	130	2766	785
Means *Moyenne*	7 461	2645	56	8 289	485	5234	1551

*When the report was going to press the 1983–84 estimates became available. In the same order as above they are 23 039, 3209, 0, 17 233, 143, 7851, and 1175. This brings the means (1974–83) to 9019, 2702, 50, 9183, 451, 5496, and 1513. These 1983–84 data became available too late to be used in the population model described by Reed and Erskine (this publication).

* *Nous n'avons reçu les données pour 1983–1984 que lorsque le document était sous presse. Elles sont, dans le même ordre que dans le tableau : 23 039, 3209, 0, 17 233, 143, 7851 et 1175. Les moyennes pour la période de 1974 à 1983 deviennent donc 9019, 2702, 50, 9183, 451, 5496 et 1513. Ces données pour 1983–1984 ont été reçues trop tard pour être considérées dans le modèle de population développé par Reed et Erskine (présente publication).*

The survey biases referred to in the previous section and listed in section 5.1 do not prevent reliable determination of the location of kill within a survey zone. Even among zones the bias effects should not vary except between Newfoundland and other areas, as discussed. We therefore interpret the distributional information from the SCS as faithfully reflecting areas of eider kill.

The 1977–80 special survey showed the area of highest kill in Newfoundland to extend from the northeast coast of Labrador to the northeast shores of Newfoundland and the southeastern coast of the island. Peak numbers of sea-duck kill were observed from December to February. Variation in ice and wind conditions among years are important in determining time and location of the kill (Wendt, Couling, and Cooch, 1979). Figure 1, from the SCS reports, confirms the distribution of eider kill locations in Labrador and Newfoundland.

The national surveys indicate that Common Eiders are the sea ducks most commonly killed by hunters in Canada. Table 3 shows how this kill is divided among provinces. The main kill areas outside Newfoundland are the eastern shore of Nova Scotia and the Gulf of St. Lawrence in Quebec.

The large increase in the kill estimate for eiders in 1983 was caused by a change in survey methodology. In 1983–84 a special delayed mailing of SCS questionnaires was sent to a sample of hunters in Newfoundland to allow preliminary investigation of the late season kill. Although a change to the SCS alone, without a matching adjustment to the NHS procedures, could not solve all the problems of estimation, the change to the survey did improve estimation of eider kill:

SCS/NHS estimate of Common Eider killed in:	1982–83	1983–84
Newfoundland	9 970	23 039
Labrador	2 236	3 209
	12 206	26 248

6.2.2. King Eider □

Although King Eiders breed abundantly throughout arctic Canada, few are available to most hunters of eastern Canada because many migrate only as far as southwestern Greenland (Palmer 1976).

Kill of King Eiders is represented in the eastern Canadian results from the national surveys only in northern Ontario, central Quebec, eastern Nova Scotia, and southern New Brunswick and amounts to less than 300 birds annually.

The numbers of King Eiders taken by native hunters are unknown, but must be trivial in comparison to deaths from natural causes (Bellrose 1976).

6.2.3. Harlequin Duck □

This species is so widely and sparsely distributed in fall and winter along the coasts of eastern Canada (Godfrey 1966) and the US as to defy accurate estimates of numbers. Palmer (1976) suggests that the eastern North American Harlequin Duck numbers "... in the hundreds, certainly not (now) in the thousands."

The annual kill of harlequins in eastern Canada is too small to measure accurately. Estimates average less than 100 birds annually and are too few to show a discernible trend.

6.2.4. Oldsquaw (Fig. 3) □

An abundant holarctic species, its nearctic breeding range covers all of arctic Canada. Order-of-magnitude estimates of population size advanced by Bellrose (1976) suggest 2 million for the western and 1.5 million for the eastern Arctic of North America. Many winter off west Greenland. Being a late fall migrant (Palmer 1976) it is not generally present on the sea-duck hunting areas of southern Canada until late in the hunting season. Large numbers overwinter in eastern Canada, as far north as Hudson Bay and with notable concentrations in the Great Lakes, along the coasts of the Atlantic Provinces (Palmer 1976) and in the gulf and estuary of the St. Lawrence (Reed and Bourget 1977). Oldsquaws are killed in many places inland, as well as on the coasts.

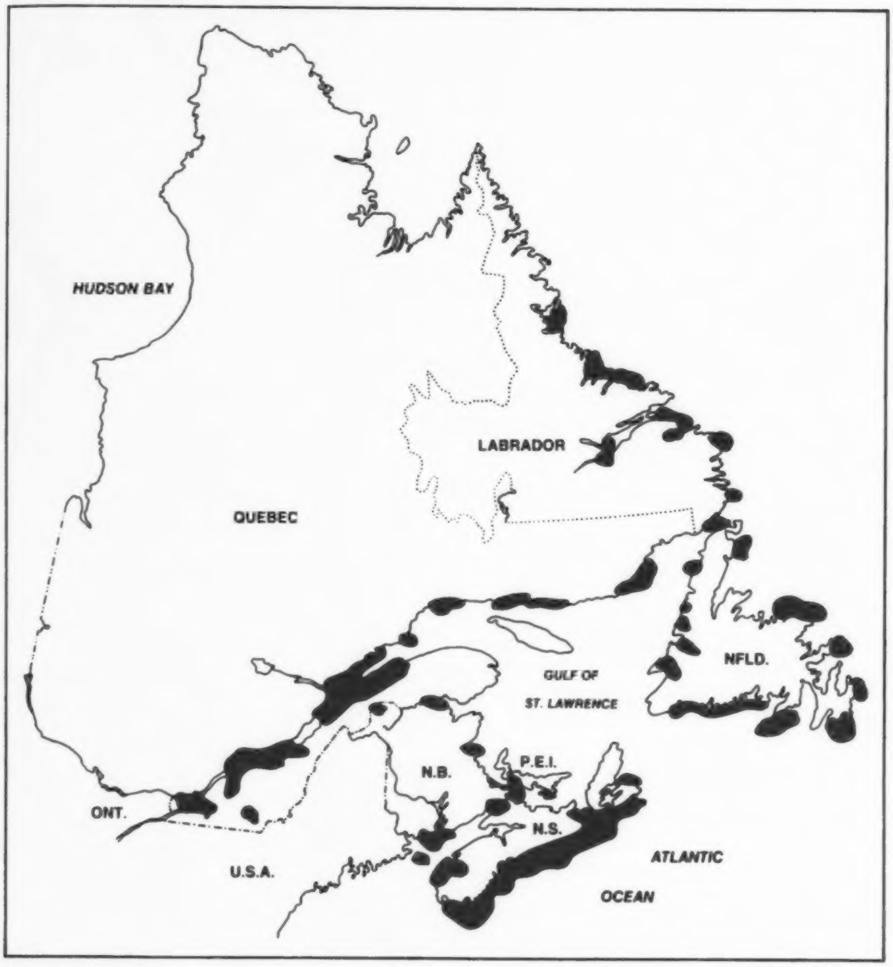


Figure 1
Major areas where Common Eiders are killed by licensed hunters
Principales régions où les Eiders à duvet sont abattus par les chasseurs munis de permis

The national surveys show kill of Oldsquaw to be highest in southern Quebec and Ontario, with substantial peaks in 1975 and 1979, when Oldsquaw made up 22% of the Canadian sea-duck kill. The reported kill in the Atlantic Provinces showed no peak in 1975 but a marked one in 1979, after several years of decline, falling again in 1980–81, along with the kill in Ontario and Quebec.

In relation to total population size, the reported eastern Canadian kill (Fig. 3) is small, with or without concern for survey biases. Additional hunting losses are inflicted by native hunters in northern Canada in all seasons (Bellrose 1976), but they are unlikely to exceed the reported kill from the national surveys and may be much less. The species is vulnerable to oil pollution, winter starvation, disease, and entanglement in fishing nets (Palmer 1976, Ellarson 1956) and it is probably these factors that are important in limiting Oldsquaw population size, rather than hunting.

6.2.5. Black Scoter (Figs. 4 and 5) □

Although Black Scoters are abundant in many areas of eastern Canada during migration, the origin of these birds is poorly documented. Until recently it was considered that the North American birds bred almost entirely in Alaska. Evidence is now accumulating to show that the open boreal forests of northern Ontario (Lumsden, cited in Bellrose 1976) and Quebec (Palmer 1976; CWS, unpubl. files; various unpublished impact reports on the James Bay hydroelectric development project) and Labrador (F. Phillips, pers. commun.) harbour appreciable numbers of breeding Black Scoters. Wings from shot birds have been submitted to the SCS from the interior of Labrador, northern Quebec, and northern Ontario; as well as from the Great Lakes – St. Lawrence River basin, the outer estuary of the St. Lawrence, and the Atlantic coasts.

The reported kill (Figs. 4 and 5) doubled from 1974 to 1977, then fell by nearly 75% in 1978, and gradually climbed again to the pre-1976 level by 1980. Such a pattern is not suggestive of a population subjected to excessive hunting. Rather, it coincides well with an environmental effect, in that the northern part of the Black Scoter wintering range had severe winters in 1976–77 and 1977–78, which could have lowered population size and led to the decreased kill in 1978.

The results from Ontario have been presented separately in Figure 5 to emphasize the different pattern in Black Scoter kill in that province. We might question whether the Black Scoter population being harvested in Ontario (Fig. 5) is the same as that being hunted further east (Fig. 4). The Ontario results have a significant peak in 1975, followed by a decline to 1980.

The types of between year changes are summarized in Table 4. In this table plus-signs show increase and minus-signs show decrease from one year to the next. A double sign indicates that the change is statistically significant under a visual application of a *t*-test, that is, when the intervals formed by one standard error on both sides of the means do not overlap. Three minus-signs in one case are used to show the strongly significant decline in 1978 east of Ontario. At least until 1980 the two figures disagree markedly in trend.

The decline in Ontario from 1975 to 1980 is consistent with response to a continual pressure, such as hunting or relatively constant habitat degradation. The pattern further east suggests a species that is regulated by natural events, including occasional catastrophes, more than by continuous, unidirectional pressure.

These graphs provide evidence that Black Scoters migrating through the Great Lakes were distinct from those migrating

Table 4
Changes in estimate of Black Scoter kill between years in Ontario, compared with the rest of eastern Canada. + means an increase and − a decrease. A double sign indicates that the change is statistically significant and a triple sign, strongly significant (see text)
Variations annuelles des nombres estimatifs de Macreuses à bec jaune abattues en Ontario et dans le reste de l'est du Canada. Le symbole + indique une augmentation et − une diminution. Un double symbole indique un changement qui est statistiquement significatif et un triple symbole, hautement significatif (voir le texte)

From *De*	To *À*	Ch. in Ont. *Var. en Ont.*	Ch. further east *Var. plus à l'est*
1974	1975	+ +	0
1975	1976	− −	+ +
1976	1977	−	+ +
1977	1978	−	− − −
1979	1980	−	+
1980	1981	+	+
1981	1982	−	−
1982	1983	+	−

further east. The most important difference was that these birds probably wintered farther south, far enough to have avoided the losses in winters 1976–77 and 1977–78. It may be that the Ontario-killed Scoters came from a different part of the breeding range, because the differences between Figures 4 and 5 persist through several years. In this case it seems likely that the Ontario-killed birds bred farther west than those killed in Quebec and east. Only the Ontario Black Scoters showed a clear change in status over the period, with a decline that may be related to hunting. Whether because of reduction of population, a change in hunting practices, or a change in migration route, the recent kill of Black Scoters in Ontario has fallen to a lower level than before 1978.

6.2.6. White-winged Scoter (Fig. 6) □

Another abundant migrant in many eastern areas, this species originates primarily from breeding grounds in western Canada (Bellrose 1976, Palmer 1976).

The eastern Canadian kill is less than that of the other scoters (Fig. 6) and was similar in showing a sharp reduction from 1977 to 1978 but has otherwise fluctuated independently, with no sign of sustained trend apparent over time. The highest estimated kill was in 1974, unlike that of any other eastern sea duck. The geographical distribution of the kill, like that of the other two scoters, is concentrated along the shores of the eastern Great Lakes and the St. Lawrence River, and in the Maritime Provinces. It differs from the others in that few are reported from Labrador, Newfoundland, and north-central Quebec. This reflects the absence of an important breeding population in northeastern Canada.

6.2.7. Surf Scoter (Fig. 7) □

The North American breeding range and migration routes of this species are similar to those of the Black Scoter, although its breeding in northern Ontario and Quebec and in Labrador, is better documented (Bellrose 1976, Palmer 1976). Surf Scoters are more important than the other species of scoters in the kill in New Brunswick, Prince Edward Island, north of 50°N, as well as in inland areas of southern Ontario and Quebec.

The kill statistics indicate a significant drop in 1978, as for the other scoters, with a recovery in 1979 resembling that of the White-winged. The kill in the Great Lakes – St. Lawrence valley has shown a downward trend, not evident to the north and east, although the results are not as suggestive as for the Black Scoter.

Figure 2
Estimated kill of Common Eiders in eastern Canada
Nombres estimatifs d'Eiders à duvet abattus dans l'est du Canada

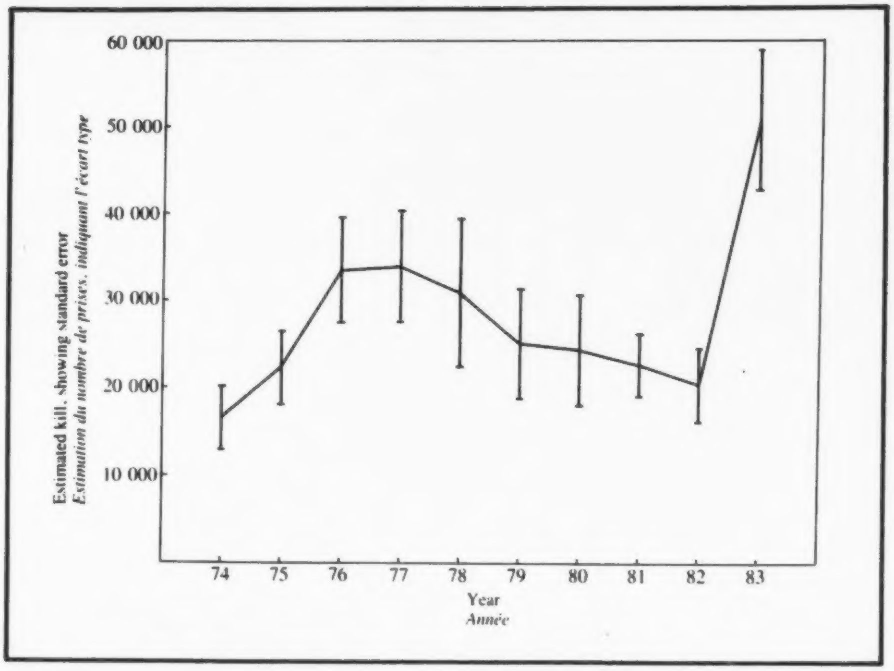


Figure 3
Estimated kill of Oldsquaws in eastern Canada
Nombres estimatifs de Canards kakawis abattus dans l'est du Canada

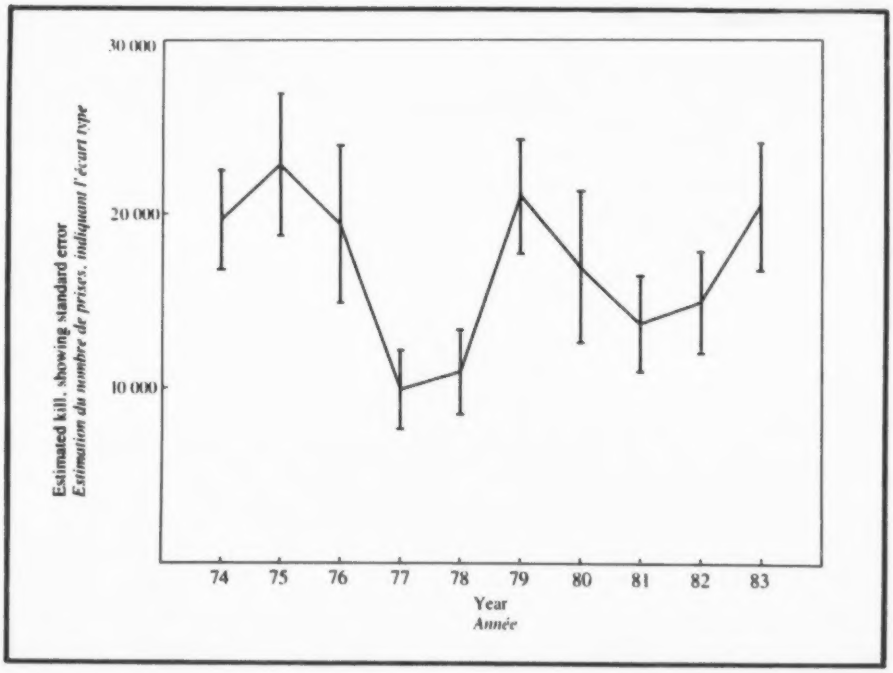


Figure 4
Estimated kill of Black Scoters from eastern Canada, excluding Ontario
Nombres estimatifs de Macreuses à bec jaune abattues dans l'est du Canada, sauf en Ontario

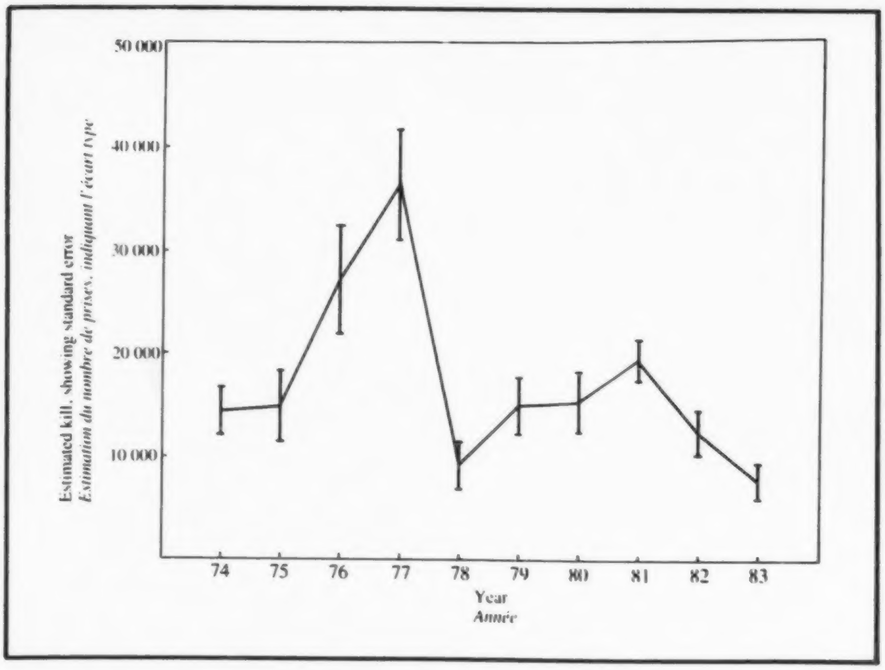
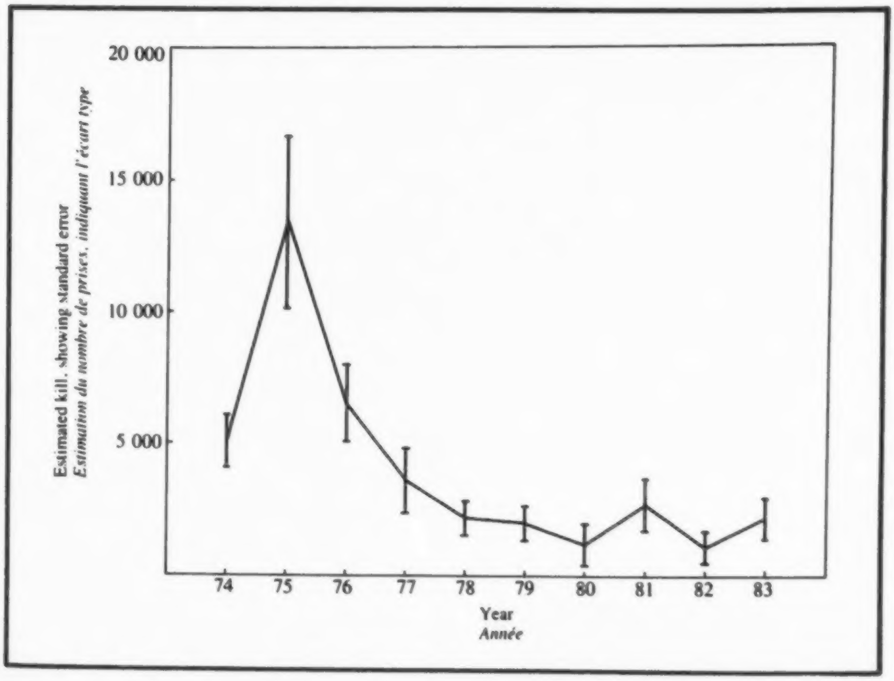


Figure 5
Estimated kill of Black Scoters in Ontario
Nombres estimatifs de Macreuses à bec jaune abattues en Ontario



7. Discussion

The reported kill of Common Eiders did not show the spectacular drop shown by the other species of sea duck from 1977 to 1978. In 1974 eiders made up 16% of the reported sea-duck kill, in 1978 40%, and in 1981 23%. The contribution of Common Eiders to the total kill of sea ducks is probably greater than these figures suggest, due to the poor representation of Newfoundland in the SCS.

As other studies in this report have emphasized, the Common Eider, which has made a notable though slow recovery in the southern half of its North American range during the last half century, is valued not only for hunting but as a source of down and, in the north, of eggs for human food. This exploitation warrants continued and improved monitoring of all uses.

Recalling that the SCS did not sample the kill in January–March, that the special survey in Newfoundland showed that nearly 50% of the kill there took place during those months, and that the kill of other sea ducks is then relatively small (most having gone further south), it is clear that a sea-duck harvest survey without a within-season bias would enlarge the estimate of the Common Eider kill considerably, while increasing the estimates for the other species comparatively little. A better timed SCS mailing in 1983 almost doubled the eider kill estimate.

The Newfoundland special survey has shown that a serious barrier to obtaining reliable sea-duck harvest estimates from hunting permit holders is the low response rate to the SCS from remote areas. Late winter hunting could be dealt with by continuing the sampling process until March, both in the SCS and NHS, if the costs to the overall survey operation were acceptable. The sampling scheme might be modified to increase the sample from coastal areas. The good response to the Newfoundland survey showed that hunters can be motivated to reply to carefully designed questionnaires that address problems of regional importance. We hope that by 1990 it will be possible, through improvements in survey design, to better specify the size and impact of the sea-duck harvest in eastern Canada. The inability to separate the two eider races in the harvest survey results is unfortunate, because a sustained kill of northern (*borealis*) eiders could mask a decrease in kill of local breeding birds (*dresseri*). It would be useful if techniques could be found to identify the wings of each race.

Figure 6
Estimated kill of White-winged Scoters in eastern Canada
Nombres estimatifs de Macreuses à ailes blanches abattues dans l'est du Canada

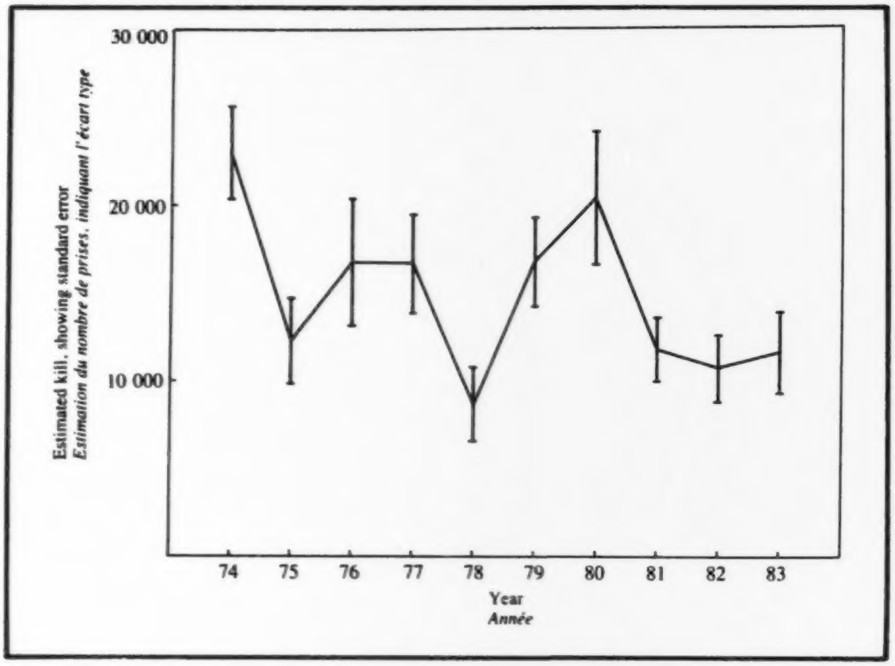
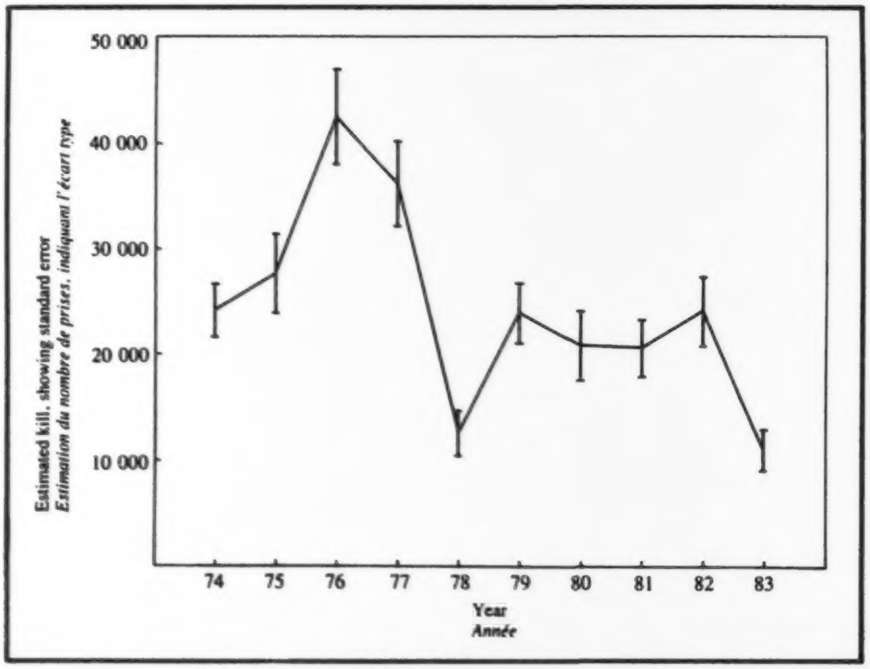


Figure 7
Estimated kill of Surf Scoters in eastern Canada
Nombres estimatifs de Macreuses à front blanc abattues dans l'est du Canada



We owe thanks to many people for help in this work, especially H. Boyd, F. G. Cooch, A. J. Erskine, A. Reed, L. Couling, and F. Phillips (who gave helpful advice on the design of the special survey).

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Part VI Conclusions

Section VI Conclusion

Common Eiders in flight off the Greenland coast
Eiders à duvet au vol, non loin des côtes du Groenland
(photo: F. Bruemmer)

Populations of the Common Eider in eastern North America: their size and status

A. Reed
A.J. Erskine

1. Abstract

Six breeding populations of Common Eiders were identified: 1) High Arctic, representing Canadian populations of Northern Eiders (*Somateria mollissima borealis*) nesting near Lancaster Sound and islands to the north; 2) Low Arctic, composed of the same subspecies nesting in Hudson Strait, northern Labrador, eastern Baffin Island, Foxe Basin, and Southampton Island; 3) Hudson Bay, made up of Hudson Bay Eiders (*S.m. sedentaria*) throughout Hudson Bay; 4) Gulf of St. Lawrence, representing American Eider (*S.m. dresseri*) populations nesting in the gulf, Newfoundland, and southern Labrador; 5) St. Lawrence estuary, composed of American Eiders nesting in the estuary; 6) Atlantic, made up of American Eider populations breeding along the Atlantic coasts of Nova Scotia and New England as well as in the Bay of Fundy. An hypothetical population model (using mainly data from nest surveys, band recoveries, and kill surveys) shows the extent of intermingling of birds from those populations during migration and wintering. It also enabled appraisal of the impact of native and non-native hunting on each population. The Atlantic and St. Lawrence estuary populations seem to be flourishing but that of the Gulf of St. Lawrence, and probably that of Hudson Bay, may be in decline. The large Low Arctic population may be barely holding its own, with some local declines, but additional data are required before its status can be determined with certainty. Data are also lacking for the small High Arctic population. Recommendations are made regarding additional research required to refine the model for management purposes: nest surveys, harvest surveys, winter surveys, banding, determination of the subspecific composition of some regional harvests and winter assemblages, as well as research on life history and the relative importance of various forms of exploitation.

2. ᓄᐃᑎᑕᐅᔪᑦ

ᐃᖕᓱᔪᕐᑐᑦ ᒥᑏᑦ ᒫᓂᓕᐅᓯᑦ ᓯᕈᐃᑕᐅᒪᕗᑦ ᓇᓗᓇᐃᕐᑕᐅᒪᑦᓯᑎᑉ: 1) ᑕᕐᕿᐅᑉ ᐅᑭᐅᕐᑕᑐᖕᓂᑦᑐᑦ, ᑭᒡᒐᑐᕐᓂᖅᑐᑦ ᑲᓇᑕᐅᑉ ᒥᑎᖅᑎᖏᓐᓂᑉ ᑕᒪᓂ ᑕᕐᕿᒥ ᐃᐸᓯᖑᕗᑦ Lancaster Sound—ᓴᓂᐊᓂ ᐊᒻᒪᓗ ᖃᑭᕐᑕᓂ ᑕᕐᕿᒥᑦᑐᓂ: 2) Hudson Strait ᒥᑦᑐᑦ, ᐊᑦᓴᓕᑦᑎᖏᑦᑐᓯᑎᑉ ᑕᑯᓇᖕᓴᐃᓐᓇᖅ ᒥᑎᕐᓂᑉ ᐱᓯᒪᑦᓯᑎᑉ ᐃᐸᓯᑦ Strait-ᒥ, ᑕᕐᕿᖕᓂᑐ ᓚᐸᑐᐊᑉ, ᓯᖄᓂᖕᓂᑐ ᖃᑭᕐᑕᓗᑉ, Foxe Basin ᐊᒻᒪᓗ Southampton Island-ᒥ; 3) ᐊᑦᓴᓐᐸᐃᒥᑦᑐᑦ, ᑕᑯᐊ ᒥᑏᑦ ᐊᑦᓴᓐᐸᐃᑉ ᒥᑎᖅᑎᖏᑦ ᐊᐸᑐᓕᒪᖕᓂ ᐊᑦᓴᓐᐸᐃᑉ ᐃᐸᓯᖑᕗᑦ; 4) St-Lawrence ᑯᖕᑕ ᐸᖕᓂᑦᑐᑦ, ᐊᒥᓇᑲᒥᐅᑦ ᒥᑎᖅᑎᒥᔭᖏᓐᓂᑉ ᑭᒐᑐᕐᓂᖅᑐᐃᑦ ᐃᐸᓯᖑᕗᑦ ᑯᑉ ᐹᖕᓂ, ᓂᐅᐸᐅᓐᓚᓐᒥᓗ, ᐊᒻᒪᓗ ᓚᐸᑐᐊᑉ ᓯᖄᓂᖕᓂ; 5) St-Lawrence Estuary ᐹᖕᑕ ᐃᖏᕐᕿᓂᐅᓂᖕᓂᑦᑐᑦ, ᐊᑦᓴᓕᑦᑎᖏᑦᑐᐳᑦ ᐊᒥᓇᑲᒥᐅᑦ ᒥᑎᖅᑎᒥᑦᓯᒥᑦ ᐃᐸᓯᑦ ᑕᒪᓂ ᐃᖏᕐᕿᓂᐅᓂᕐᒥ ᑎᓂᑦᑕᑐᔪᒥ ᐅᓕᑦᑕᓯᓂᓗ; 6) Atlantic ᒥᑦᑐᑦ, ᐊᒥᓇᑲᒥᐅᑦ ᒥᑎᖅᑎᖏᓐᓄᑦ ᐃᓕᖕᓂᖅᐳᑦ ᒫᓂᓕᐅᕐᓯᑎᑉ Nova Scotia-ᐅᑉ ᐊᒻᒪᓗ New England-ᐅᑉ ᒪᓂᒐᓴᑉ ᑲᖏᕐᓱᖕᓂ Fundy-ᐅᑉ. ᖃᐅᔨᒪᔭᐅᑦᓯᐊᕿᓂ ᒥᑏᑦ ᐱᓂᐊᕐᑕᐅᓯᒪᓂᖕ (ᒪᑯᓂᖕ ᐊᑐᕐᓯᑎᑉ ᖃᐅᔨᒐᓯᐊᕐᓂᐅᓯᒪᔪᑎᒍᑦ ᐃᐸᐱᖏᑎᒍᑦ, ᑕᓕᐊᕈᓯᖏᑦᑕᓗ ᐱᔭᐅᓯᒪᓂᖏᕐᑎᒍᑦ ᒥᑎᕐᓂᐊᑕᐅᓂᖏᑎᒍᓐᓗ ᖃᐅᔨᓴᕐᑕᐅᒪᓂᖏᑦ) ᓄᐃᑕᑎᑦᓯᒐᔭᕐᓂᒥᑉ ᖃᓄᐃᓐᓗᐊᓂᓐᔭᖕᓂᑉ ᐊᑦᓴᓕᑦᑎᖏᓂᖏᓐᓄᑦ ᑎᒻᒥᐊᑦ ᑕᑯᓇᖕ ᐱᓯᒪᔪᕐᓯᑎᑉ ᒥᑎᕐᓂᑉ ᐊᐅᓚᑎᓐᓗᒥᑦ ᐊᒻᒪᓗ ᐅᑭᐅᕐᓯᐅᐱᖏᓐᓂᑦ. ᖃᐅᔨᒪᓇᑦᓯᐊᕿᓂᓗ ᓄᓇᓕᑦᑐᖅᐃᑦ ᓄᓇᑐᖅᐅᖏᑐᐃᓐᓗ ᒥᑎᕐᓂᐊᓂᓇᓯᒪᔭᖕ ᖃᓄᐃᓕᖕᓂᑦᓯᓯᐊᕿᓗᐊᕐᒪᖕᑦ. ᐃᒪᐃᓐᓂᕿᕐᑕᐅᓂᖃᓚᐅᑦᓯᓂᓗ ᑕᑯᐊ Atlantic-ᒥ ᐊᒻᒪᓗ St-Lawrence estuary ᖕᓂᑦᑐᑦ ᒥᑏᑦ ᐱᕈᕐᐸᓕᐊᑦᓯᐊᓇᐊᖏᑦ ᑭᓯᐊᓂ ᒪᓂᑦᑐ Gulf of St-Lawrence ᐸᖕᓂ, ᐊᒻᒪᓗ ᐃᒪᖅ ᐊᑦᓴᓐᐸᐃᒥᑦᑐᑦ, ᐃᑭᓕᐸᓪᓕᐊᑎᓪᓗᒥᑦ. ᐊᒥᓯᒪᓐᓗ Hudson Strait-ᐅᑉ ᒥᑎᖅᑎᒥᔭᖏᑦ ᑕᒪᓐᓗᑯᑦᑐᔭᓕᕐᓯᑎᑉ, ᐱᑦᔪᑎᒥᑦᓯᒥᑦ ᐃᑭᓕᐸᓪᓕᐊᓂᖏᑦ, ᑭᓯᐊᓂᓕ ᖃᐅᔨᓴᓇᓐᓚᓂᖅᓴᐊᖃᕈᔭᕐᐳᖅ ᐱᐅᓯᓐᓚᓐᑕᖏᑦ ᓱᖁᐃᑕᐅᓚᓐᖏᓂᖏᓐᓂ. ᐱᐅᓯᓇᔭᐅᔪᓐᓗ ᖃᐅᔨᓕᓯᐊᕐᓂᑯᑦ ᐱᐱᑦᓴᖃᐃᓯᐊᑦᓯᐊᒍᑎᑦ ᑕᒪᓂ ᐅᑭᐅᕐᑕᑐᖅ ᑕᕐᕿᖕᑕ ᒥᑎᖅᑎᒥᔭᖏᓐᓂ ᑭᓯᐊᓂ ᑕᐃᒪᐃᓕᖕᑦᓴᐃᓇᓕᑕᑦᑐᐳᐊᓗᑉ. ᑎᒋᐅᓇᓂᒥᐊᓐᓚᖅ ᑕᒪᑐᒥᖕ ᖃᐅᔨᓴᓇᐊᓐᓚᓂᕐᒍᑦ ᐊᕐᐱᑕᕐᓂᒍᑦ ᐊᕐᐱᑕᕐᓂᒍᑦ ᐊᒻᒪᓗ ᑕᓕᐊᕈᓯᕐᑐᐃᓂᕐᒍᑦ ᐱᑕᖃᓇᐊᓐᓚᓇᐊᖃᕐᐳᖅ ᖃᐅᔨᓴᑦᓯᐊᕈᑎᐅᒐᔭᕐᓗᓂ ᐊᐅᓚᑦᓯᓂᓕᓇᓂᕐᒍᐊᖕᓗᓂ.

3. Introduction

The other papers in this publication add significantly to our previous knowledge (earlier reviewed by Palmer [1976], Bellrose [1980], and others) of Common Eider populations in North America. It is now possible to identify certain populations that show different ranges and migration routes, and their status. There is still a scarcity of relevant data, and much speculation was required in developing a preliminary population model. The tentative nature of many of our conclusions should not, however, detract from this paper of which the main aims are to identify existing problems in the conservation of the species and to point out pertinent gaps in our knowledge.

We have identified a number of breeding populations, based on subspecific make-up, geographic range, and migration and exploitation patterns. The major harvest areas are also identified. Through the construction of a population model, we trace various breeding groups through a full annual cycle, assessing their losses from hunting. In this way some light is shed on the hunting pressure that is exerted on each group, and when and where that pressure occurs.

4. Methods and materials

Most of the population and harvest data used in the analyses came from other articles in this publication. We also used preliminary results of a survey of native take of eiders and eider eggs for the Baffin

(photo: A. Reed)

Region (App. 1) and an unpublished monthly breakdown of those harvests for northern Quebec (App. 2). We examined all band recovery information for Common Eiders in Canada and the U.S., up to and including 1982.

The methods used to construct the population model are described in Appendix 3.

For the purposes of this paper the summer is considered to extend from June to August, the fall from September to November, the winter from December to February, and the spring from March to May.

5. The breeding population groups

The Common Eider population of eastern North America can be subdivided into three units, based on subspecific identity. These units occupy relatively distinct breeding ranges (*S.m. sedentaria* in Hudson Bay, *S.m. borealis* in the eastern Arctic, and *S.m. dresseri* along the Atlantic coast from south-central Labrador southward and in the St. Lawrence), although some range overlap and intergradation occur. Because they occupy broad geographic ranges, each unit contains several sub-units whose migration and exploitation patterns are different. For management purposes it is more meaningful to examine the status of populations at the sub-unit level, rather than at the subspecific level. The data are still inadequate to allow us to confidently define and to assess the status of all of the possible sub-units. Some, however, can be identified (e.g., that of the St. Lawrence estuary) but in many cases lumping into broader categories is necessary. We have identified six breeding population groups of which three are subdivisions of the *S.m. dresseri* unit, two from the *S.m. borealis* unit, and one for *S.m. sedentaria*. Additional research will undoubtedly allow further breakdown of the population.

5.1. High Arctic, Northern Eider (*Somateria mollissima borealis*) □

A number of small colonies bordering Lancaster Sound and the islands to the north (see Abraham and Finney, this publication) form the core of a population which is geographically separated from the main concentrations of the same subspecies near Hudson Strait and along the west coast of Greenland. In the fall birds from this group migrate eastwards through Jones and Lancaster Sounds and southwards through Smith Sound. The recovery in southwest Greenland of a bird originally banded as a nesting female on northern Devon Island (Hussell and Holroyd 1974) shows that some individuals from this group join the large concentration of birds wintering off the southwest coast of Greenland (Salomonsen 1967). Probably others from the High Arctic group move down the east coast of Baffin Island to winter near the entrance to Hudson Strait, or further south, but this has not been documented.

5.2. Low Arctic, Northern Eider (*S.m. borealis*) □

This group is made up of the very large breeding populations on both shores of Hudson Strait as well as the smaller ones in northern Labrador and near Southampton Island. The scattered populations elsewhere on Baffin Island (but excluding its northern tip) and in Foxe Basin are tentatively included in this group. Further research will probably indicate the need to subdivide this group. On fall migration some birds move southeasterly down the east coast of Baffin Island (see Fig. 5 in Abraham and Finney, this publication) and others go easterly through Hudson Strait (Fig. 5 in Abraham and Finney, this publication; see also Fig. 5 in Nakashima, this publication). Recoveries of adult females banded near Cape Dorset have been obtained as far south as the Gulf of St. Lawrence (one recovery) and eastern Newfoundland (two), but some eiders remain near the eastern entrance to Hudson Strait all winter (Nakashima, this publication). The relatively small number of birds of this subspecies which overwinter off the coast of New England (Mendall 1980) probably come from this group.

5.3. Hudson Bay, Hudson Bay Eider (*S.m. sedentaria*) □

This includes the entire stock and range of the subspecies which breeds and is assumed to overwinter within Hudson and James Bays.

5.4. Gulf of St. Lawrence, American Eider (*S.m. dresseri*) □

In addition to the gulf proper, this group includes the coast of Labrador south of approximately 54°30′ N, as well as all of the island of Newfoundland. The few band recoveries, mostly from south Labrador bandings, indicate that birds from this group move south to wintering areas off Nova Scotia and New England, although some remain as far north as southern Newfoundland. The American Eiders which overwinter in the gulf (Reed *et al.*, this publication) probably originate from this group.

5.5. St. Lawrence Estuary, American Eider (*S.m. dresseri*) □

This group comprises the birds nesting in the estuary. Almost all overwinter off southwestern Nova Scotia or off New England, migrating by a coastal route through the gulf, or across the Chignecto

Isthmus, or directly overland (Reed 1975, Gauthier *et al.* 1976), but small numbers may remain in the gulf.

5.6. Atlantic, American Eider (*S.m. dresseri*)

This group is made up of birds nesting on the Atlantic coast of Nova Scotia, in the Bay of Fundy, and on the coast of Maine. Band recoveries reveal that the Nova Scotia eiders move only a short distance southwestwards along the coast, or cross to the nearby shores of Maine and Massachusetts to winter. The New Brunswick and Maine birds are more or less sedentary, their winter range differing from the breeding area only by a slight southward extension to include the coast of Massachusetts, although some immatures disperse to Nova Scotia in their first autumn (Wakeley 1973). With additional data it may prove feasible to recognize the Nova Scotia population as a distinct subunit, but at present this would only add unnecessary complexity to the analyses.

6. Harvest and wintering areas

6.1. Southwest Greenland

The large wintering concentration of eiders (mainly *S.m. borealis* and *S. spectabilis*) in this area is made up of birds from western Greenland (Salomonsen 1967) as well as some from the Canadian High Arctic group. They sustain heavy hunting pressure by local Greenlanders (Salomonsen 1967).

6.2. High Arctic

Small hunts take place out of the five Inuit communities located there, almost entirely in May to September (Donaldson 1984). Few if any eiders overwinter in the area.

6.3. Low Arctic

Six Inuit communities on Baffin Island, two in Foxe Basin (Donaldson 1984), eight in northern Quebec (JBNQNHRC 1982), three in northern Labrador, and one on Southampton Island hunt eiders in this area. Most hunting occurs in the spring, summer, and fall. Some birds are also killed in winter in Hudson Strait and Cumberland Sound, where small numbers overwinter (Abraham and Finney, this publication; Nakashima, this publication).

6.4. Hudson Bay

Along the east coast of the bay, the number of eiders killed has been documented in three Quebec communities and one on the Belcher Islands (Donaldson 1984, JBNQNHRC 1982); it occurs in all months. Two other Quebec settlements and several others along the south and west coasts of the bay undoubtedly take some eiders as well. The entire population of the Hudson Bay subspecies is believed to overwinter there but its distribution at that time is poorly documented (Abraham and Finney, this publication).

6.5. Newfoundland and Labrador

Eiders are shot along the coasts of Labrador and Newfoundland. The study of Wendt and Silieff (this publication) covers all of that kill except a small, although unquantified, amount by native and other subsistence hunters. Heavy hunting occurs off the east coast of Newfoundland, legally from late November to early March, and illegally until late April. This is an important overwintering area for Northern Eiders (Bourget *et al.*, this publication; Mendall 1980).

6.6. Gulf of St. Lawrence

In this important wintering area hunting occurs principally along the gulf coasts of Quebec, New Brunswick, Nova Scotia, and the west coast of Newfoundland. The open season extends from October through December, remaining open into January in Nova Scotia, February along the north shore and on the Magdalen Islands, and early March in western Newfoundland. Some illegal shooting continues into or resumes in spring along the north shore, in the Strait of Belle Isle, and in eastern New Brunswick. Most of the kill occurs in the inner portion of the gulf and on the north shore, reflecting human population distribution.

6.7. St. Lawrence estuary

Hunting takes place in the estuary between late September and late December and kills locally produced birds (all band recoveries occurring there come from local bandings). Very few eiders overwinter in that area.

6.8. Atlantic

The hunts occurring on the Atlantic coast of Nova Scotia; in the lower Bay of Fundy; in Maine, New Hampshire, and Massachusetts are included here. The season extends from October to mid-January in Nova Scotia, to February in New Brunswick, and to early March in the United States. The birds killed comprise locally produced American Eiders, others from the gulf and estuary groups, as well as a few Northern Eiders from the Low Arctic group. Wintering occurs throughout the area with especially important concentrations off the coasts of Maine and Massachusetts.

7. A population model

Field observations and band recovery data were used to determine the qualitative relationships between the various population groups and hunting–wintering areas (Fig. 1).

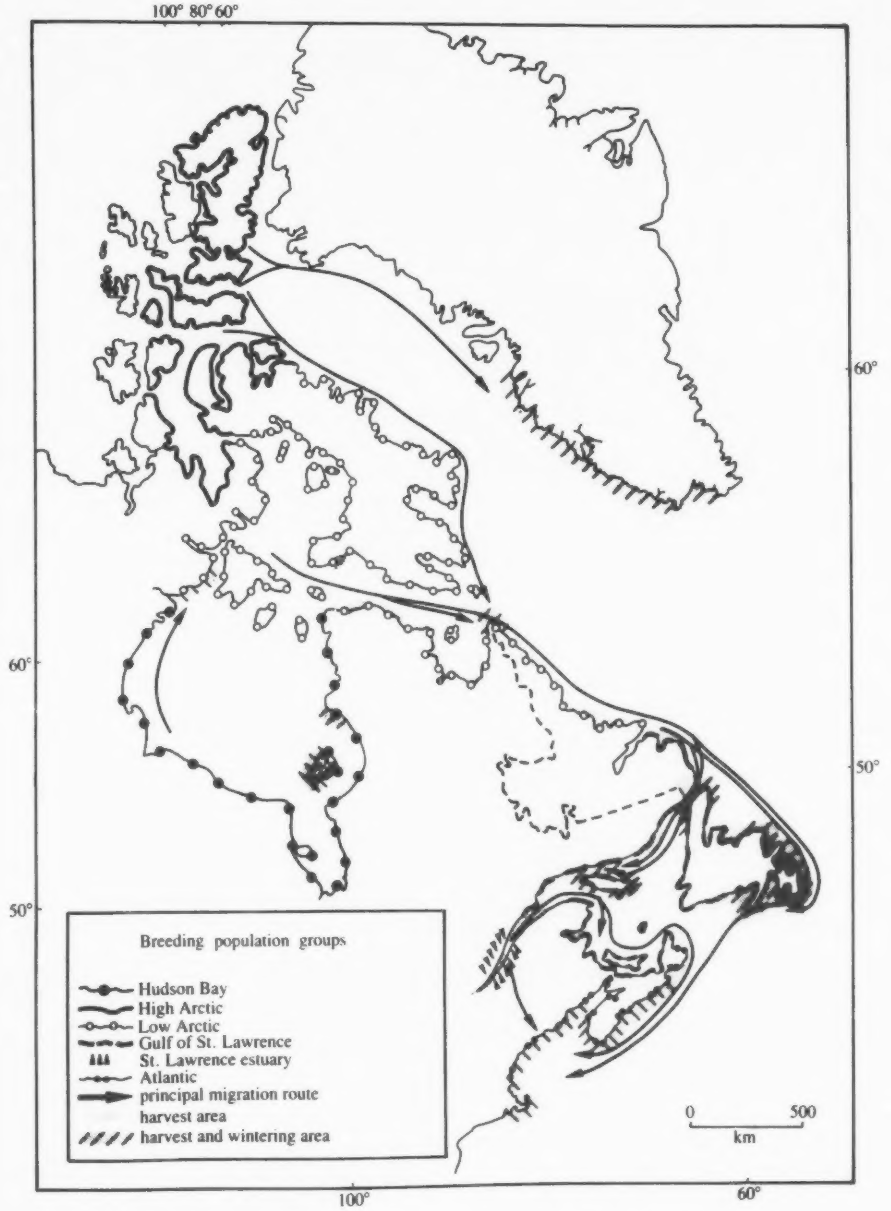
We have constructed a preliminary quantitative model (Fig. 2) which attempts to trace the fall flights from each population group from 1 September through August of the following year, subtracting hunting losses throughout the year, and adding the summer production of young birds to arrive at an end-of-year population balance. Quantifying those relationships proved difficult because banding information was incomplete and population data of unknown reliability. To complete the model certain assumptions had to be taken and choices made between different data sets. The model does not provide a precise and sophisticated quantification but rather a "broad-brush" approximation, using the best available data, to serve as an aid in management decisions. As such it provides a background for speculative discussions on the status of population groups (section 8) and for identifying weaknesses in the data base. The details of its construction are provided in Appendix 3 to allow the reader to assess the quality of the data and the validity of the assumptions, as well as to permit the integration of new and better data as they become available.

Non-hunting losses of fully-grown birds were too poorly documented to be treated in the model. Reports of such losses usually invoke fox predation and disease in nesting concentrations (Quinlan and Lehnhausen 1982, Reed and Cousineau 1967), freezing-in of birds in staging waters (Barry 1968), and oil slicks on feeding or resting areas (Griscom and Snyder 1955). Those factors can claim large numbers of birds, but such events generally occur locally and infrequently, and may not have an important long-term influence on overall numbers. For our purposes we have assumed non-hunting losses of fully-grown birds to be negligible in comparison to hunting losses.

8. Discussion

The combined fall flight of all population groups is within a few percent of the estimated population size at the year's end (Fig. 2), suggesting that our estimates are more or less plausible. That suggestion of overall stability in the combined population is in agreement with the general impressions formed from the individual papers in this publication (see also Bellrose 1980). In the following paragraphs we discuss the possible status of each group, comparing results from the model with other evidence from the literature.

Figure 1
Breeding population groups, harvest areas, and wintering areas of Common Eiders in eastern North America



8.1. The Hudson Bay group □

This group shows a discrepancy of −5% which could readily be explained by an underestimation of breeding numbers (see Abraham and Finney, this publication). The harvests of birds and eggs by subsistence hunters on the Belcher Islands and the Quebec communities of Kuujjuaraapik and Inukjuak appear large in relation to the apparent sizes of the local breeding populations. Chapdelaine and Tremblay (1979) conducted an aerial survey of the Quebec coast of Hudson Bay in 1978 and compared their results with those of a similar survey in 1954; they suggested that a decline had occurred.

8.2. The High Arctic group □

A discrepancy of −14% is indicated by the model, but this seems most likely to be the result of an underestimation of breeding numbers or an over-estimation of kill, or both. Hunting pressure on this stock within its suspected Canadian range does not appear great, but it may be more important for the component that migrates to Greenland, where heavy hunting occurs (Salomonsen 1967).

8.3. The Low Arctic group □

According to the model, the estimated population at the year's end was within 1% of the original fall flight. Chapdelaine and Tremblay (unpubl.) suspected that the Ungava Bay population had remained more or less unchanged between 1954 and 1978. Bruemmer (1982) also suggested that populations in the Middle Savage Islands were relatively stable. In contrast, Cooch (this publication) documented a dramatic decrease in breeding populations on several islands near the Cape Dorset settlement as a result of intensive hunting of adult females and eggs. Although the number of birds and eggs taken in the breeding season from the Cape Dorset area is exceptionally high, and it is also high near other Hudson Strait communities (Reed, this publication), the impact on the overall population may be lessened by the existence of several important breeding concentrations well removed from human settlements. Further stress is placed on this population in winter by intensive hunting in Newfoundland, in Labrador, and on the north shore of the Gulf of St. Lawrence. There is sufficient contradictory evidence on the status of this numerically and economically important group to justify increased research and monitoring.

8.4. The Gulf of St. Lawrence group □

The model suggests a discrepancy of almost −40%. Although there is strong evidence that north shore and Newfoundland components of this group have been struggling against abusive hunting for many decades (Chapdelaine, Dupuis, *et al.*, this publication; Lock, this publication) the decline suggested by the model is obviously exaggerated. Parts of the southern Labrador component may be increasing (Lock, this publication), but those of Newfoundland and the north shore clearly require increased protection.

8.5. The St. Lawrence estuary group □

This population showed an apparent increase of 8% which is in general agreement with field data which show it to be flourishing (Chapdelaine, Dupuis, *et al.*, this publication).

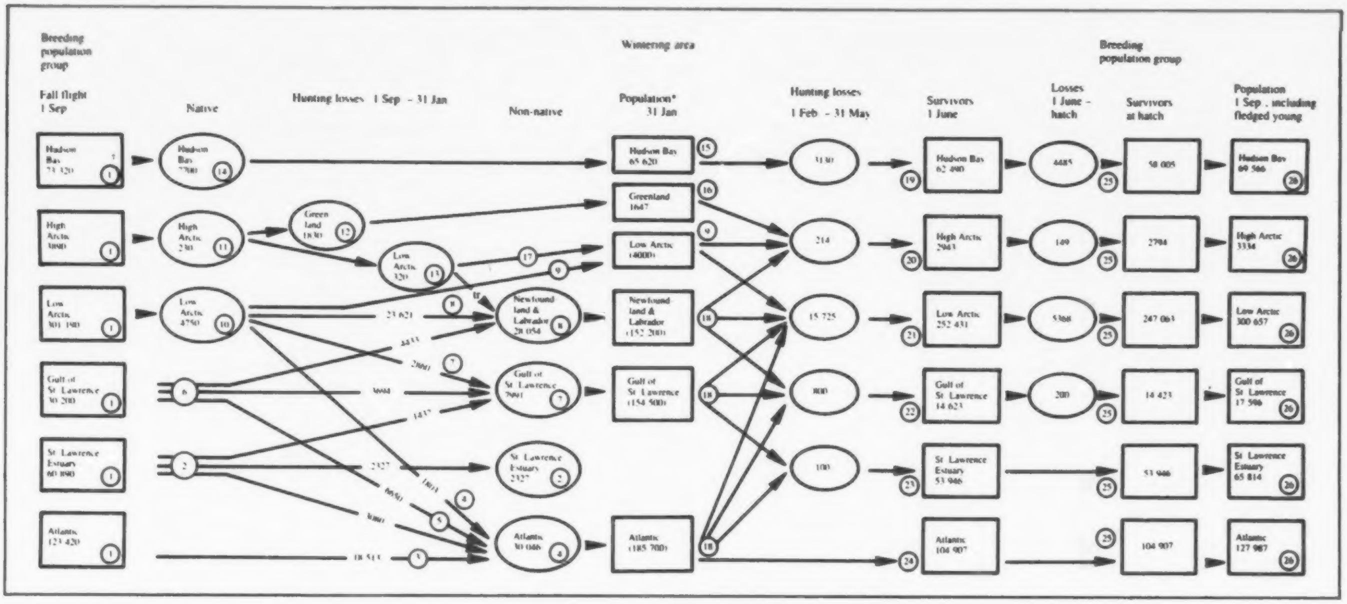
8.6. The Atlantic population group □

Estimates for this group showed no striking discrepancy, which is in agreement with field data that suggest that most components are stable or increasing (Mendall 1968; Cannell and Maddox 1983; Erskine and Smith, this publication).

8.7. Some ecological considerations □

The present exercise has highlighted the extent to which the three subspecies of eastern Canada (American, Northern, and Hudson Bay Eiders) come into close contact in summer, and American and Northern Eiders overlap extensively in some staging and wintering areas. Canadian

Figure 2
Hypothetical model of Common Eider populations and harvest, eastern North America


Breeding population group
Fall flight 1 Sep
Wintering area
Hunting losses 1 Sep – 31 Jan
Native
Non-native
Population* 31 Jan
Hunting losses 1 Feb – 31 May
Survivors 1 June
Breeding population group
Losses 1 June – hatch
Survivors at hatch
Population 1 Sep, including fledged young
Hudson Bay 73 120 † ①
High Arctic 3890 ①
Low Arctic 301 190 ①
Gulf of St Lawrence 30 200 ①
St Lawrence Estuary 60 890 ①
Atlantic 123 420 ①
Hudson Bay 7700 ⑭
High Arctic 230 ⑪
Low Arctic 4750 ⑩
Greenland 1830 ⑫
Low Arctic 320 ⑬
⑥
②
23 621
4433
2000
3000
1437
2327
1000
6650
3000
18 513
⑰
⑨
⑧
⑦
④
⑤
③
Newfoundland & Labrador 20 054 ⑧
Gulf of St Lawrence 7991 ⑦
St Lawrence Estuary 2327 ②
Atlantic 30 046 ④
Hudson Bay 65 620 ⑮
Greenland 1647 ⑯
Low Arctic (4000) ⑨
Newfoundland & Labrador (152 200) ⑱
Gulf of St Lawrence (154 500) ⑱
Atlantic (185 700) ⑱
3130
214
15 725
800
100
Hudson Bay 62 490 ⑲
High Arctic 2943 ⑳
Low Arctic 252 431 ㉑
Gulf of St Lawrence 14 623 ㉒
St Lawrence Estuary 53 946 ㉓
Atlantic 104 907 ㉔
4485
149
5368
200
㉕
58 005
2794
247 063
14 423
53 946
104 907
Hudson Bay 69 566 ㉖
High Arctic 3334 ㉖
Low Arctic 300 657 ㉖
Gulf of St Lawrence 17 596 ㉖
St Lawrence Estuary 65 814 ㉖
Atlantic 127 987 ㉖

*The values in parentheses are from field surveys (Bourget *et al.*, this publication; Abraham and Finney, this publication), those for Hudson Bay and Greenland are derived by subtracting losses for fall flights. The Greenland value represents the estimated number of Canadian-produced birds that overwinter in southwest Greenland with a large population of west Greenland birds (Salomonsen 1967)

†The numerals enclosed in small circles correspond to steps used in the construction of the model. Those steps are described in Appendix 3.

Northern Eiders migrating to southwest Greenland probably also come in contact with the Icelandic subspecies, *S.m. islandica*. Such a degree of intermingling explains the existence of intergrades, especially between American and Northern Eiders (Mendall 1980, this publication). Indeed it is surprising that intergrades are as uncommon as they are, which suggests that a high degree of assortative mating is occurring.

Presumably the three eastern North American subspecies formerly occupied distinct ranges. During the Pleistocene, the American race perhaps occupied the Atlantic coast south of the ice sheet, and the Northern race an arctic refugium, perhaps near Baffin Bay. The Hudson Bay subspecies, however, may have evolved since the last glacial retreat, as Hudson Bay was largely ice-covered before that; similarities in size and bill shape suggest that it evolved from the American subspecies. Hudson Bay may have been originally invaded by migrating *dresseri*, overland across the then reduced land barrier between the Tyrrell Sea (Hudson Bay) and the Champlain Sea (Gulf of St. Lawrence: see Shilts 1982 and Prest *et al.* 1970); as climatic warming allowed permanent open water, and as the isostatic rebound enlarged the barrier, the group became sedentary and lost contact with those of the Atlantic coast (see also Todd 1963 and Snyder 1941).

It is generally considered that Hudson Bay Eiders remain within Hudson Bay throughout the year (Palmer 1976). Field observations (cf. Prach *et al.* 1981; Abraham and Finney, this publication) and harvest surveys (Appendices 1 and 2) indicate that Common Eiders are present in Hudson Bay all year, but whether the entire population of *S.m. sedentaria* remains there has not been firmly established. It is difficult to imagine how, in winter when ice cover is extensive (Stirling 1981, Fig. 1), such a large population could be accommodated within the bay (and be detected by so few ornithological observers). It is possible that some migrate to Hudson Strait to overwinter or continue to the Labrador coast or further south, but no evidence of such movements has yet been obtained. Two accidental deaths (H. Ouellet, pers. commun.) and one band recovery of *S.m. sedentaria* in south-central Canada over the past few decades undoubtedly represent unusual occurrences, provoked perhaps by exceptionally severe ice conditions.

The American Eider generally migrates southwards, with the bulk of the population overwintering near the southern limit of its breeding range. However, some individuals overwinter as far north as the Gulf of St. Lawrence's north shore. Most Northern Eiders migrate beyond the southern boundary of their breeding range, the exceptions remaining in Hudson Strait and southwest Greenland. The general trend for both subspecies is for more northerly components to migrate longer distances but nevertheless to winter to the north of the southerly components. A similar pattern was described for Northern Eiders from Greenland (Salomonsen 1967).

Two major wintering areas, Anticosti–Mingan and Nova Scotia – New England, are also important for breeding. Heavy use of an area in winter does not make it unsuitable for breeding; possibly food requirements change, from large bivalves and sea urchins in winter to fish spawn, crustaceans, and small gastropods during nesting and brood rearing (Cantin *et al.* 1974). Males in moult probably require a diet similar to that of breeding females and ducklings (Pethon 1968); their moult migration may reduce pressure on food supply in the breeding area (Salomonsen 1968). Unfortunately our knowledge on moult migrations and moulting areas is very fragmentary, except for that provided by the Ungava Bay Inuit (Nakashima, this publication).

9. Management and conservation implications

The principal value of the present study is to point out future research needs (those are discussed in the following section) but some of the results have immediate implications for management.

Presently four major breeding areas can be recognized: the Hudson Strait area (including northern Labrador, Ungava Bay, Cumberland Sound, and eastern Southampton Island) which harbours more than 90 000 breeding pairs of Northern Eiders, approximately 98% of the estimated total for that subspecies in Canada (Abraham and Finney, this publication); the eastern Hudson Bay area (including the Quebec coast and the Belcher Islands) with more than 20 000 breeding pairs of Hudson Bay Eiders, approximately 92% of the total for that subspecies (Abraham and Finney, this publication); the St. Lawrence estuary with 18 500 pairs of American Eiders, almost 30% of its total population (Chapdelaine, Dupuis, *et al.*, this publication); and the Atlantic area (principally the east shore of Nova Scotia and the coast of Maine) with approximately 37 500 pairs of American Eiders, 58% of the total. All of those areas deserve special attention in regard to habitat protection. The recent threat of cottage and port development to many St. Lawrence estuary colonies is now much reduced because CWS has gained direct custodianship of many strategic islands, and private conservation associations own several others. But there, as well as in the Atlantic area and in the Hudson Strait, marine feeding areas remain vulnerable to degradation from hydrocarbons and other pollutants.

The Gulf of St. Lawrence breeding area (including the north shore, Newfoundland, and southern Labrador) presently harbours fewer than 10 000 pairs of American Eiders (Chapdelaine, Dupuis, *et al.*, this publication; Lock, this publication). However, a much larger population could undoubtedly be accommodated if more effective control of abusive exploitation was brought to bear.

Three wintering areas emerge as being of major importance: the east coast of Newfoundland with a wintering population probably in the order of 150 000 birds, mainly Northern Eiders; the Anticosti–Mingan area of the Gulf of St. Lawrence with approximately 150 000 eiders (both Northern and American); and the Atlantic area (including the coasts of southern Nova Scotia, Maine, and Massachusetts), with more than 180 000 birds, mainly American Eiders (Bourget *et al.*, this publication). Vigilance is required in all three areas because eiders are vulnerable to hydrocarbon pollution in all of them. Illegal shooting in spring and late winter is common on the north and west shores of the gulf and around Newfoundland; deep-rooted traditions of spring hunting die hard in such remote locations, but there is room for optimism now that Anticosti Island has become a provincial park, the Mingan Islands are being established as a national park, and education on conservation matters is making headway in several north shore communities (Blanchard 1984).

10. Recommendations for further study

Our population model represents a crude attempt to sort out the impact of hunting in eastern North America on various population groups. Refining it to an extent where it can be used confidently for management decisions requires additional nest surveys, harvest surveys, winter surveys, banding, and determination of the subspecific composition of some regional hunting kills and winter assemblages, as well as better information on life history. Research is also required on the relative importance of various forms of hunting and egg and down collection on populations.

10.1. Nest surveys

Most of the range of the American Eider, and the Ungava Bay and northern Labrador components of the Northern Eider have been surveyed with acceptable precision. Periodic repetition of those surveys should provide indications of important population changes. The remaining portion of the range of the Low Arctic population group, because of its numerical importance, merits further survey work; the south coast of Baffin Island should be censused in detail, and exploratory surveys in Foxe Basin, Southampton Island and east-central Baffin Island are needed. In the High Arctic, high logistic costs and a wide dispersion of small colonies render extensive surveys out of the question, but additional exploration in the course of other work would be useful. Nest surveys of Hudson Bay Eiders are badly needed; detailed surveys are called for along the Quebec coast and near the Belcher Islands, and more extensive ones along the south and west coasts.

10.2. Harvest surveys

Surveys of the recreational kill in southern Canada and the United States require considerable refinement; it is extremely important to reconcile the large differences between national harvest surveys and special sea duck surveys (see Wendt and Silieff, this publication). Native harvest surveys should be repeated, at least periodically, throughout northern Quebec, and modified to allow distinction between King and Common Eiders. The Baffin Region harvest survey should be planned to continue at suitable intervals. It is important to obtain harvest estimates for native communities in southern and western Hudson Bay and on Southampton Island.

10.3. Winter surveys

Accurate estimates of wintering populations are complicated by their use of offshore areas which makes complete coverage difficult, the danger of operating aircraft over open water in winter, and because of the uncertainty of visual estimates of large flocks. The need to distinguish King and Common Eiders is a further complicating factor, especially in Hudson Strait and Greenland.

Despite those drawbacks it would be useful to pursue research on winter survey techniques (see Bourget *et al.*, this publication), because a refined method could provide essential information on overall population trends if applied to the three major wintering concentrations off the east coast of continental North America: Newfoundland, Anticosti–Mingan and Nova Scotia – New England. Exploratory surveys to establish the distribution and abundance of Hudson Bay Eiders in Hudson Bay and Roes Welcome Sound are needed.

10.4. Banding

A great deal of additional banding is needed to help trace the various population units to their respective wintering areas and to assess the impacts of hunting on them. Although substantial numbers of eiders have been banded in the St. Lawrence estuary, on the east shore of Nova Scotia and in Maine, most of them have been nesting females, thus providing an incomplete picture of migration routes and schedules. Adult males, owing to their moult migrations (Salomonsen 1968), are undoubtedly distributed quite differently from adult females and young in late summer and fall. Young birds probably show a wider dispersal in winter than the adults (Wakeley 1973). Banding of adult male and young cohorts would be valuable in the three breeding locations mentioned above. In all other major breeding areas, banding of all cohorts is needed. Of greatest priority are the populations of the Low Arctic and the Gulf of St. Lawrence, followed by those of the High Arctic and Hudson Bay.

10.5. Determination of the subspecific composition of harvests and wintering populations

Knowing the subspecific composition of flocks on staging and wintering areas would help trace the various populations and their contributions to regional harvests. Unfortunately subspecific identification is not possible from the wings sent in by hunters participating in the national Species Composition Surveys. Mendall's (this publication) key now allows such identification providing heads or whole carcasses are available. Using this technique during field bag checks would provide valuable information, especially if conducted in major hunting areas such as Newfoundland, the Gulf of St. Lawrence, and Nova Scotia – New England.

10.6. Impact of harvesting

Eiders of some population groups are subjected to hunting in all months of the year, as well as egging and down-collecting during the summer. To properly manage future exploitation it is important to know the relative impact of each form of harvesting as well as their overall effect on populations. How much greater an impact does spring shooting have than fall shooting? Would curtailment of spring exploitation by subsistence hunters result in sufficiently larger allowable fall and winter harvests to compensate? Could the spring needs of subsistence hunters be met, partially or fully, by other sources of food and, if not, is it advantageous to minimize the kill of adults in favour of a larger egg harvest? To answer those and other related questions, additional banding and harvest surveys are needed, as well as further field research such as that reported by Cooch (this publication).

11. Acknowledgements

We thank S. Wendt who provided band recovery information, the many people who conducted the banding, and the hunters who reported banded eiders. J. Donaldson, Baffin Region Inuit Association, provided unpublished results of Baffin Region harvest surveys and L. Brooke, Makivik Corporation, extracted unpublished monthly breakdowns of eider kills in northern Quebec from records of the James Bay and Northern Quebec Native Harvest Research Committee.

La taille et l'état des populations d'Eider à duvet dans l'est de l'Amérique du Nord

A. Reed
A.J. Erskine

1. Résumé

Nous distinguons six populations nicheuses d'Eider à duvet, désignées comme suit : 1) celle du Haut-Arctique, qui comprend la population canadienne de *Somateria mollissima borealis* nichant près du détroit de Lancaster et des îles situées plus au nord; 2) celle du Bas-Arctique, composée de colonies de la même sous-espèce qui nichent dans le détroit d'Hudson, sur la côte est de l'île de Baffin, dans la partie septentrionale du Labrador, dans le bassin Foxe et dans l'île Southampton; 3) celle de la baie d'Hudson, constituée des colonies de *S.m. sedentaria* nichant à l'intérieur de cette baie; 4) celle du golfe du Saint-Laurent, comprenant les populations de *S.m. dresseri* nichant dans le golfe, à Terre-Neuve et dans la partie méridionale du Labrador; 5) celle de l'estuaire du Saint-Laurent, qui représente des *S.m. dresseri* nichant dans l'estuaire; 6) celle de l'Atlantique, comprenant les populations nicheuses de *S.m. dresseri* des côtes atlantiques de la Nouvelle-Écosse et de la Nouvelle-Angleterre ainsi que celles de la baie de Fundy. À l'aide de données provenant de relevés de nids, d'enquêtes sur les prises et de la recapture d'oiseaux bagués, nous avons construit un modèle hypothétique de population afin de montrer jusqu'à quel point ces populations s'entremêlent au cours des migrations et de l'hivernage. Ce modèle a également servi à évaluer l'incidence de la chasse par les autochtones et les non-autochtones sur chaque population. Deux populations, celles de l'Atlantique et de l'estuaire du Saint-Laurent, semblent bien se porter, mais celle du golfe du Saint-Laurent est apparemment surexploitée et il demeure possible qu'il en soit de même dans le cas de celle de la baie d'Hudson. L'importante population du Bas-Arctique semble être relativement stable dans l'ensemble, avec certaines baisses locales, mais il faudrait disposer d'autres données pour se prononcer avec certitude sur son état. Pour la petite population du Haut-Arctique, les données sont incomplètes. On formule des recommandations relatives à la recherche requise pour perfectionner le modèle pour les besoins : relevés de nids, enquêtes sur les prises, inventaires hivernaux, baguage, établissement de la composition sous-spécifique des oiseaux abattus et de certaines populations hivernantes, études sur l'histoire naturelle et recherche sur l'importance relative des différentes formes d'exploitation.

2. Introduction

Les données que les exposés contenus dans le présent rapport nous fournissent sur les populations d'Eider à duvet nichant en Amérique du Nord sont un précieux apport à la somme de nos connaissances, déjà enrichies par les travaux de Palmer (1976), de Bellrose (1980) et d'autres auteurs. Il est maintenant possible de désigner certaines populations distinctes selon l'aire de distribution de chacune et les voies migratoires qu'elles empruntent, et de faire le bilan de leur situation. La quantité de données nécessaires pour mettre au point un modèle préliminaire de population est encore fort pauvre et nous avons souvent dû recourir à des hypothèses. Malgré le caractère spéculatif de plusieurs de nos conclusions, nous estimons néanmoins faire ici oeuvre utile, dans la mesure où notre but est avant tout de signaler les problèmes que pose la conservation de l'espèce et les questions auxquelles il importe de trouver réponse.

Nous avons réparti les colonies nicheuses en différentes populations, selon les sous-espèces qui les composent, selon leur aire de distribution et selon leur schéma de migration et d'exploitation. Nous avons également délimité les principales zones de chasse. Le modèle de population que nous avons mis au point nous permet de suivre toutes les étapes du cycle annuel pour chacune des populations nicheuses en tenant compte des pertes dues à la chasse. Il est ainsi plus facile d'évaluer la pression que la chasse exerce sur chaque population et d'établir où et quand s'exerce cette pression.

3. Méthodes et matériaux

Presque toutes les données sur les prises et les populations qui ont servi à nos analyses furent extraites d'autres articles publiés dans le présent rapport. Nous avons en outre utilisé les résultats préliminaires d'enquêtes sur les prises d'eiders et sur le ramassage d'oeufs d'eider par les autochtones de la région de l'île de Baffin (annexe 1), de même qu'une analyse mensuelle non publiée de ces mêmes données pour le Nord québécois (annexe 2). Nous avons aussi étudié tous les renseignements diffusés jusqu'en 1982 inclusivement sur la recapture d'Eiders à duvet bagués au Canada et aux États-Unis.

On trouvera à l'annexe 3 la description des méthodes utilisées pour construire le modèle de population.

Pour les besoins de notre article, il est convenu que l'été dure de juin à août, l'automne de septembre à novembre, l'hiver de décembre à février et le printemps de mars à mai.

4. Les populations nicheuses d'Eider à duvet

On peut reconnaître trois sous-divisions de la population de l'Eider à duvet dans l'est de l'Amérique du Nord, selon les sous-espèces. Chacune occupe une aire de nidification relativement distincte (*Somateria mollissima sedentaria* dans la baie d'Hudson, *S.m. borealis* dans l'est de l'Arctique canadien et *S.m. dresseri* le long du littoral de l'Atlantique au sud de la partie sud-centrale du Labrador et dans le Saint-Laurent), quoiqu'il existe un peu de chevauchement d'aires et d'oiseaux de formes intermédiaires. En raison des vastes territoires occupés, chaque sous-espèce est probablement composée de plusieurs sous-unités caractérisées par des schèmes de migration et d'exploitation différents. Pour fins de gestion, il est préférable d'analyser l'évolution des populations au niveau des sous-unités, plutôt qu'au niveau des sous-espèces. Les données sont toujours insuffisantes pour identifier avec confiance toutes les sous-unités possibles, et d'analyser leur situation. Quelques-unes sont, par contre, identifiables (à titre d'exemple celle qui niche dans l'estuaire du Saint-Laurent), mais dans la plupart des cas, nous sommes dans l'obligation de les regrouper en catégories plus larges. Nous avons identifié six populations nicheuses, dont trois représentent des sous-divisions de *S.m. dresseri*, deux de *S.m. borealis* et une de *S.m. sedentaria*. Des recherches ultérieures permettront sans doute de ventiller la population dans un nombre encore plus grand de sous-unités.

4.1. Haut-Arctique (*S.m. borealis*) □

Un certain nombre de petites colonies en bordure du détroit de Lancaster et des îles situées plus au nord (voir Abraham et Finney, présente publication) forment le noyau d'une population relativement isolée des principales concentrations de la même sous-espèce nichant près du détroit d'Hudson et le long de la côte ouest du Groenland. Pour leur migration automnale, les oiseaux de cette population volent en direction est, empruntant les détroits de Jones et de Lancaster, et en direction sud par le détroit de Smith. La recapture au sud-ouest du Groenland d'une femelle nicheuse qui avait été baguée dans le nord de l'île Devon (Hussell et Holroyd, 1974) indique que certains individus de cette population rejoignent la grande concentration d'oiseaux signalée au large de la côte sud-ouest du Groenland (Salomonsen, 1967). Il est probable que d'autres individus appartenant à la population du Haut-Arctique descendent le long de la côte est de l'île de Baffin pour passer l'hiver près de l'entrée du détroit d'Hudson, ou plus au sud, mais ceci n'a pas encore été confirmé.

4.2. Bas-Arctique (*S.m. borealis*) □

Cette population se compose de plusieurs colonies sur les deux rives du détroit d'Hudson de même que de plus petites du nord du Labrador et du voisinage de l'île Southampton. Nous y avons inclus provisoirement les populations locales dispersées ailleurs sur l'île de Baffin (excluant toutefois la pointe nord de celle-ci) et dans le bassin Foxe. Il est possible que des recherches additionnelles démontrent le besoin de subdiviser cette population. À l'époque de la migration d'automne, certaines bandes se dirigent en direction sud-est le long de la côte orientale de l'île de Baffin (voir figure 5, Abraham et Finney, présente publication) et d'autres volent en direction est par le détroit d'Hudson (*ibid.*; voir aussi figure 5, Nakashima, présente publication). La recapture de femelles adultes baguées près de Cape Dorset (T.N.-O.) indique que le déplacement migratoire vers le sud atteint parfois le golfe du Saint-Laurent (une recapture) et l'est de Terre-Neuve (deux), mais certains groupes demeurent tout l'hiver près de l'embouchure orientale du détroit d'Hudson (Nakashima, présente publication). Le contingent relativement peu nombreux de cette sous-espèce qui hiverne au large de la côte de la Nouvelle-Angleterre (Mendall, 1980) appartient probablement à cette population.

4.3. Baie d'Hudson (*S.m. sedentaria*) □

Cette population englobe la totalité des effectifs et de l'aire de distribution de la sous-espèce qui, présumément, se reproduit et hiverne à l'intérieur de la baie d'Hudson et de la baie James.

4.4. Golfe du Saint-Laurent (*S.m. dresseri*) □

En plus du golfe proprement dit, l'aire de distribution de cette population comprend la partie méridionale de la côte du Labrador, à partir d'environ 54°30′N, de même que Terre-Neuve en entier. Les quelques recaptures d'oiseaux bagués (la plupart bagués au sud du Labrador) indiquent que le gros des volées migratoires de cette population se déplace en direction sud vers des aires d'hivernage situées au large des côtes de la Nouvelle-Écosse et de la Nouvelle-Angleterre. Toutefois, certains individus demeurent tout l'hiver plus au nord dans la partie méridionale de Terre-Neuve. Les contingents d'eiders de cette sous-espèce qui passent l'hiver dans le golfe (Reed *et al.*, présente publication) appartiennent probablement à cette population.

4.5. Estuaire du Saint-Laurent (*S.m. dresseri*) □

Cette population se compose des oiseaux qui nichent dans l'estuaire. Ils hivernent presque tous au large de la côte sud-ouest de la Nouvelle-Écosse ou au large de la Nouvelle-Angleterre, émigrant soit par une voie côtière survolant le golfe, soit en survolant l'isthme de Chignecto, soit en coupant directement par les terres (Reed, 1975; Gauthier *et al.*, 1976), mais il peut arriver que de petits groupes demeurent dans le golfe.

4.6. Atlantique (*S.m. dresseri*) □

Cette population se compose d'oiseaux nichant sur la côte atlantique de la Nouvelle-Écosse, dans la baie de Fundy et sur la côte du Maine. Les recaptures d'oiseaux bagués révèlent que les eiders venant de Nouvelle-Écosse ne se déplacent vers le sud-ouest que sur une courte distance le long de la même côte, ou traversent pour aller hiverner sur les côtes avoisinantes du Maine et du Massachusetts. Ceux du Nouveau-Brunswick et du Maine sont plus ou moins sédentaires, leurs quartiers d'hivernage ne différant de leurs quartiers de reproduction que par un léger prolongement vers le sud pour englober la côte du Massachusetts, mais il arrive que des juvéniles choisissent la Nouvelle-Écosse comme terme de leur première migration automnale (Wakeley, 1973). Avec des informations additionnelles, il serait peut-être possible de reconnaître la population de la Nouvelle-Écosse comme sous-unité distincte, mais pour l'instant, cette distinction n'apporterait que de la complexité inutile aux analyses.

5. Les régions d'exploitation et les aires d'hivernage

5.1. Sud-ouest du Groenland □

La grande concentration d'eiders (surtout les *S.m. borealis* et les *S. spectabilis*) qui hivernent dans cette région, se compose de contingents venus de l'ouest du Groenland (Salomonsen, 1967) et de quelques bandes appartenant à la population canadienne du Haut-Arctique. Ces oiseaux subissent de fortes pressions de la part des chasseurs groenlandais (Salomonsen, 1967).

5.2. Haut-Arctique □

Les cinq collectivités inuit qui habitent cette région y font des prises peu importantes, presque toutes entre mai et septembre (Donaldson, 1984). Si des eiders y passent l'hiver, ils sont peu nombreux.

5.3. Bas-Arctique □

Dans cette région, la chasse à l'eider est pratiquée par six collectivités inuit de l'île de Baffin, deux du bassin Foxe (Donaldson, 1984), huit dans le Nord québécois (JBNQHRC, 1982), trois dans le nord du Labrador et une dans l'île Southampton. Les prises ont surtout lieu au printemps, en été et en automne. On tue aussi quelques oiseaux en hiver dans le détroit d'Hudson et dans le détroit de Cumberland, où hivernent de petites populations (Abraham et Finney, présente publication; Nakashima, présente publication).

5.4. Baie d'Hudson □

Le long de la côte est de la baie, on a relevé des prises dans trois localités du Québec et dans les îles Belcher (Donaldson, 1984; JBNQHRC, 1982); on y chasse l'eider toute l'année. Il en est sans doute de même pour deux autres agglomérations au Québec et plusieurs autres des côtes sud et ouest de la baie d'Hudson. Nous supposons que toute la population de *S.m. sedentaria* hiverne à cet endroit, mais il existe peu de données sur sa distribution à ce moment de l'année (Abraham et Finney, présente publication).

(photo: A. Reed)

5.5. Terre-Neuve et Labrador □

On chasse l'eider le long des côtes du Labrador et de Terre-Neuve. L'étude de Wendt et Silieff (présente publication) porte sur la totalité des prises, sauf un nombre restreint mais non quantifié d'individus tués par les autochtones et autres chasseurs de subsistance. La chasse est intensive au large de la côte est de Terre-Neuve, légalement de la fin de novembre au début de mars et, illégalement, jusqu'à la fin d'avril. Cette région est une importante zone d'hivernage pour les *S.m. borealis* (Bourget *et al.*, présente publication; Mendall, 1980).

5.6. Golfe du Saint-Laurent □

Dans cette importante aire d'hivernage, on chasse l'Eider à duvet surtout le long des rives du golfe au Québec, au Nouveau-Brunswick, en Nouvelle-Écosse et sur la côte ouest de Terre-Neuve. La saison de la chasse s'échelonne d'octobre à la fin de décembre, se prolongeant jusqu'en janvier en Nouvelle-Écosse, jusqu'en février le long de la Côte-Nord et aux Îles-de-la-Madeleine, et jusqu'au début de mars dans l'ouest de Terre-Neuve. La chasse se poursuit ou se reprend illégalement au printemps le long de la Côte-Nord, dans le détroit de Belle-Isle et dans l'est du Nouveau-Brunswick. La plupart des eiders sont abattus dans la partie intérieure du golfe et sur la Côte-Nord, reflétant la distribution de la population humaine.

5.7. Estuaire du Saint-Laurent □

Dans l'estuaire, les prises ont lieu entre la fin de septembre et la fin de décembre et se composent d'oiseaux appartenant à la population locale (le baguage de tous les oiseaux bagués recapturés dans cette région était d'origine locale). Très peu d'eiders hivernent dans cette région.

5.8. Atlantique □

Sont incluses ici les prises de la côte atlantique de la Nouvelle-Écosse, celles de la baie de Fundy, du Maine, du New Hampshire et du Massachusetts. La saison de chasse dure d'octobre à la mi-janvier en Nouvelle-Écosse; elle se prolonge jusqu'en février au Nouveau-Brunswick et jusqu'au début de mars aux États-Unis. Les prises comprennent des *S.m. dresseri* appartenant à la population nicheuse locale et à deux autres populations, celle du golfe du Saint-Laurent et de l'estuaire du Saint-Laurent, de même qu'un certain nombre de *S.m. borealis* appartenant à la population du Bas-Arctique. Des eiders hivernent un peu partout dans la région, mais on trouve des concentrations particulièrement importantes au large des côtes du Maine et du Massachusetts.

6. Un modèle de population

Nous avons utilisé des données provenant d'observations sur le terrain et des recaptures d'oiseaux bagués pour déterminer les rapports qualitatifs entre les populations désignées et les aires de chasse ou d'hivernage (figure 1).

Nous avons élaboré aussi les bases préliminaires d'un modèle quantitatif (figure 2) qui vise à suivre les volées d'automne de chacune des populations, entre le 1er septembre et le 31 août de l'année suivante, en soustrayant les pertes dues à la chasse et en additionnant la production estivale des jeunes eiders, pour obtenir un bilan de fin d'année pour chaque population. La quantification de ces rapports s'est révélée plus difficile, à cause du petit nombre d'oiseaux bagués parmi certaines populations, et à cause de certaines estimations de population et de prises dont la précision n'était pas connue. Pour compléter le modèle nous avons dû admettre certaines suppositions et choisir entre différentes séries de données. Il faut reconnaître que le modèle ne prétend pas fournir une estimation précise et sophistiquée, mais plutôt une approximation établie à partir des données que nous jugions être les plus pertinentes et qui permettront aux gestionnaires de prendre des décisions plus éclairées. Ce modèle servira de base aux analyses préliminaires sur l'état des populations (section 7) et à l'identification des faiblesses de la base des données. Les données ayant servi à la construction du modèle sont fournies dans l'annexe 3 pour permettre aux lecteurs d'en évaluer la qualité et la valeur des suppositions, et d'y intégrer de nouvelles données au fur et à mesure de leur disponibilité.

Nos connaissances sur la mortalité adulte attribuable à des facteurs autres que la chasse sont inadéquates pour être incluses dans le présent modèle. Parmi les causes de ces pertes non cynégétiques, on mentionne la prédation par les renards et les épidémies dans les colonies (Quinlan et Lehnhausen, 1982; Reed et Cousineau, 1967), l'emprise des eiders dans les glaces nouvellement formées (Barry, 1968) et la pollution par les hydrocarbures dans les aires d'alimentation et de repos (Griscom et Snyder, 1955). Les pertes peuvent être spectaculaires, mais ces événements ne sont qu'occasionnels et plutôt localisés de sorte qu'il est probable que leur incidence sur la population totale ne soit que mineure, à long terme. Nous avons donc supposé, pour le présent exercice, que la mortalité non cynégétique est négligeable, en comparaison avec celle attribuable à la chasse.

7. Analyse

Selon notre modèle, la volée d'automne de toutes les populations combinées n'est différente que par un faible pourcentage de la population en fin d'année (figure 2), ce qui donne à penser que nos estimations sont tout à fait plausibles. Cette suggestion de stabilité dans l'ensemble de la population concorde avec l'impression générale qui se dégage des autres travaux dont fait état la présente publication (voir aussi Bellrose, 1980). Dans les paragraphes qui suivent, nous discutons de l'état probable de chaque population désignée en comparant les résultats fournis par le modèle à des informations relevées dans la littérature.

7.1. Baie d'Hudson □

Cette population affiche une divergence de 5 %, qui pourrait facilement s'expliquer par une sous-estimation du nombre des reproducteurs (voir Abraham et Finney, présente publication). Les prises lors de la chasse et le ramassage des oeufs pour fins de subsistance aux îles Belcher et dans les localités de Kuujjuaraapik et d'Inukjuak, au Québec, semblent toutefois élevées par rapport à la taille apparente de la population reproductrice locale. Chapdelaine et Tremblay (1979) ont fait un relevé aérien de la rive québécoise de la baie d'Hudson en 1978, puis en ont comparé les résultats à ceux d'une enquête analogue effectuée en 1954; d'après leurs constatations, il semblait y avoir eu déclin de la population.

7.2. Haut-Arctique □

D'après le modèle, il y avait divergence de − 14 %, mais ce résultat est fort probablement imputable à une sous-estimation du nombre des reproducteurs ou à une surestimation des prises, ou à ces deux facteurs à la fois. La pression de chasse exercée sur cette population à l'intérieur de son aire présumée de distribution au Canada ne semble pas considérable, mais il est possible que cette pression soit plus importante sur les volées migratoires qui séjournent au Groenland, où la chasse est intensive (Salomonsen, 1967).

7.3. Bas-Arctique □

Selon le modèle, il y avait moins de 1 % de différence entre la population estimée en fin d'année et la volée migratoire d'automne. Chapdelaine et Tremblay (1979) concluaient que l'effectif de la baie d'Ungava était demeuré à peu près inchangé entre 1954 et 1978. Bruemmer (1982) avançait les mêmes conclusions concernant les effectifs des îles centrales des Sauvages. Par contraste, les données recueillies par Cooch (présente publication) indiquaient un déclin marqué des populations reproductrices nichant sur plusieurs îles des environs de Cape Dorset, dû à de forts prélèvements de femelles adultes et d'oeufs. Malgré le chiffre exceptionnellement élevé des prises rapportées par les chasseurs de la région de Cape Dorset pendant la saison de reproduction et un chiffre également élevé pour d'autres localités du détroit d'Hudson (Reed, présente publication), l'incidence des prises sur la population totale est probablement atténuée par l'existence de plusieurs concentrations importantes de reproducteurs à bonne distance des régions habitées. Cette population est encore davantage exposée à des pertes en hiver, car elle subit alors de fortes pressions de chasse à Terre-Neuve, au Labrador et sur la rive nord du golfe du Saint-Laurent. Il existe suffisamment d'indices contraires au sujet de son état pour justifier qu'on y intensifie les recherches et la surveillance de cette population numériquement et économiquement importante.

Figure 1
Lieux de reproduction, des prises et d'hivernage des différentes populations d'Eider à duvet dans l'est de l'Amérique du Nord

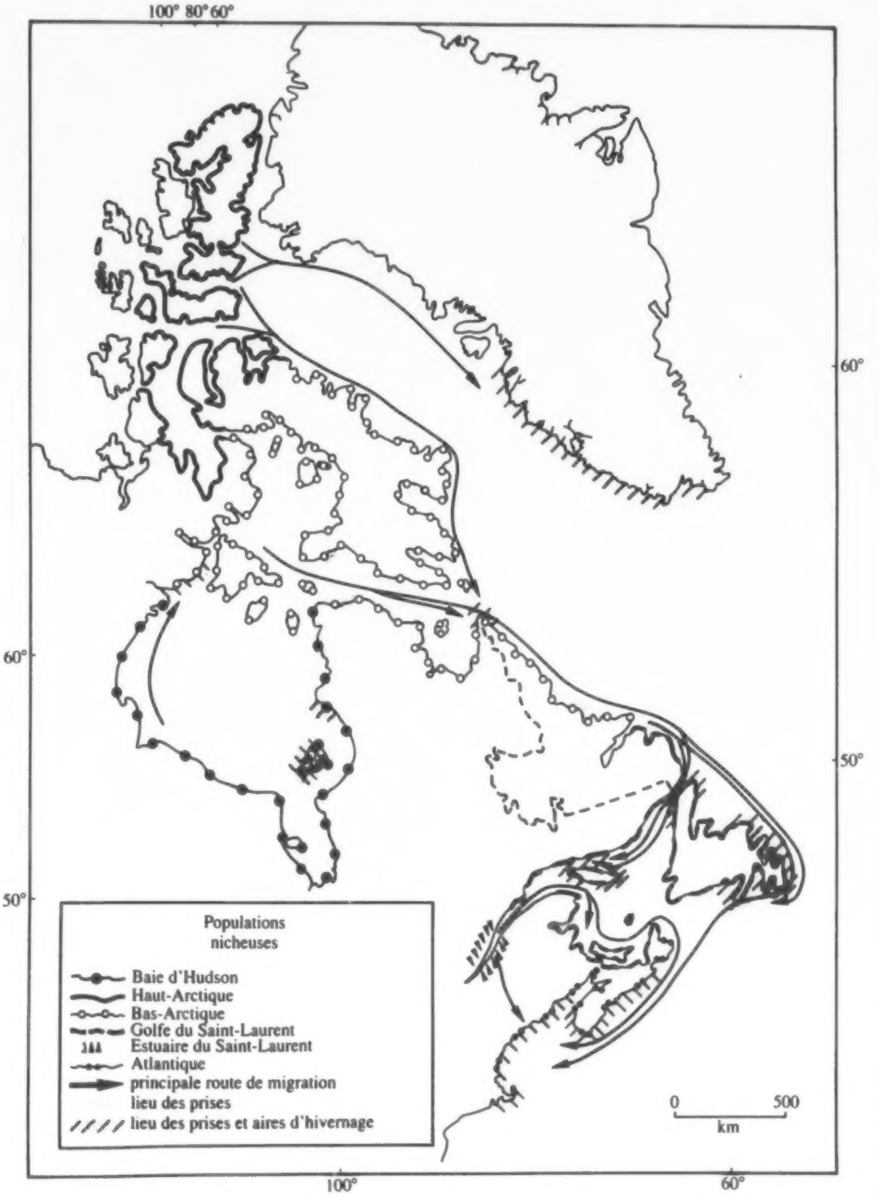
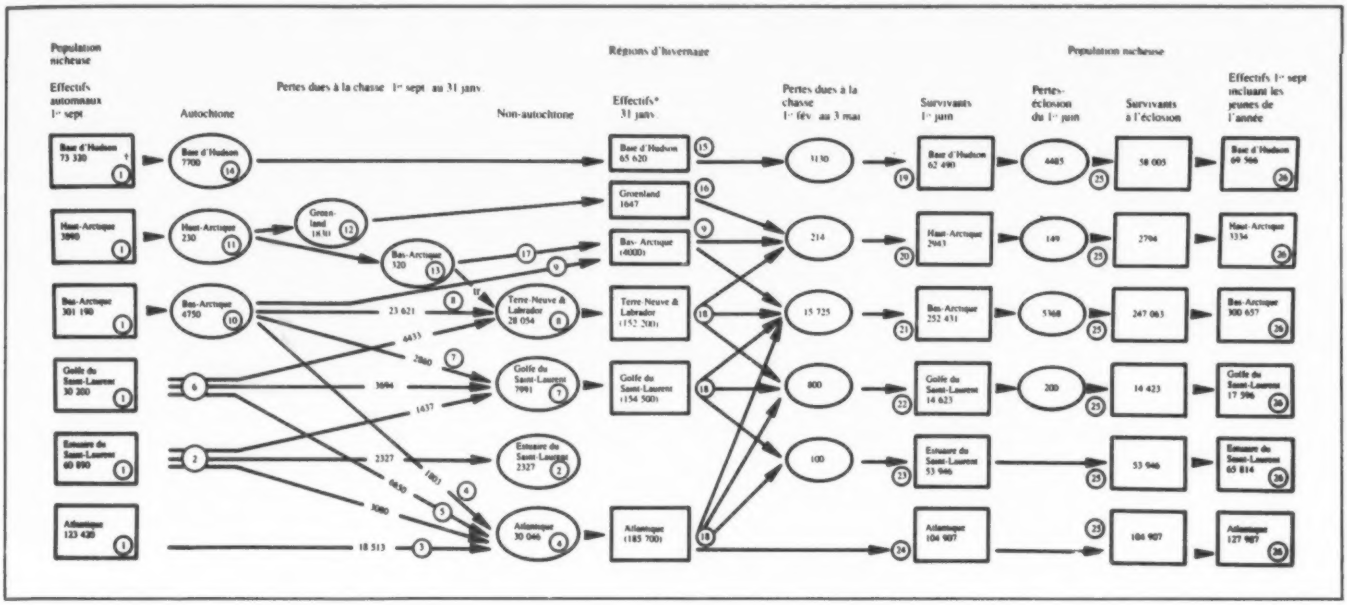


Figure 2
Modèle hypothétique des populations d'Eider à duvet et le nombre de prises lors de la chasse, dans l'est de l'Amérique du Nord


Population nicheuse
Effectifs automnaux 1er sept
Pertes dues à la chasse 1er sept. au 31 janv.
Autochtone
Non-autochtone
Régions d'hivernage
Effectifs* 31 janv.
Pertes dues à la chasse 1er fév. au 3 mai
Population nicheuse
Survivants 1er juin
Pertes-éclosion du 1er juin
Survivants à l'éclosion
Effectifs 1er sept incluant les jeunes de l'année
Baie d'Hudson 73 320 †
Haut-Arctique 3890
Bas-Arctique 301 190
Golfe du Saint-Laurent 30 200
Estuaire du Saint-Laurent 60 890
Atlantique 123 420
Baie d'Hudson 7700
Haut-Arctique 230
Groenland 1830
Bas-Arctique 320
Bas-Arctique 4750
23 621
6433
2860
3694
1637
2327
1801
6630
3080
18 513
Terre-Neuve & Labrador 28 054
Golfe du Saint-Laurent 7991
Estuaire du Saint-Laurent 2327
Atlantique 30 046
Baie d'Hudson 65 620
Groenland 1647
Bas-Arctique (4000)
Terre-Neuve & Labrador (152 200)
Golfe du Saint-Laurent (154 500)
Atlantique (185 700)
3130
214
15 725
800
100
Baie d'Hudson 62 490
Haut-Arctique 2943
Bas-Arctique 252 431
Golfe du Saint-Laurent 14 623
Estuaire du Saint-Laurent 53 946
Atlantique 104 907
4485
149
5368
200
58 005
2794
247 063
14 423
53 946
104 907
Baie d'Hudson 69 566
Haut-Arctique 3334
Bas-Arctique 300 657
Golfe du Saint-Laurent 17 596
Estuaire du Saint-Laurent 65 814
Atlantique 127 987
†

*Les chiffres entre parenthèses ont été obtenus par des relevés sur le terrain (Bourget *et al.*, Abraham et Finney, présente publication), ceux pour la Baie d'Hudson et le Groenland ont été obtenus en soustrayant les pertes dues à la chasse des effectifs automnaux du 1er septembre. Le chiffre pour le Groenland ne représente que les oiseaux d'origine canadienne, qui hivernent dans le sud-ouest du Groenland en compagnie d'une importante population d'eider en provenance de la côte ouest du Groenland (Salomonsen, 1967).

†Les chiffres encerclés correspondent aux étapes de construction du modèle. Ces étapes sont décrites en annexe 3.

7.4. Golfe du Saint-Laurent □

D'après le modèle, il y avait divergence d'environ −40 %. Même s'il ne fait guère de doute que cette population est victime de surexploitation sur la Côte-Nord et à Terre-Neuve depuis plusieurs décennies (Chapdeleine *et al.*, présente publication; Lock, présente publication), le taux annuel de déclin auquel aboutit le modèle est manifestement exagéré. Il y a probablement un accroissement des effectifs du sud du Labrador (Lock, présente publication), mais ceux de Terre-Neuve et de la Côte-Nord ont nettement besoin d'être mieux protégés.

7.5. Estuaire du Saint-Laurent □

Cette population montrait un gain apparent de 8 %, ce qui concorde en général avec les données recueillies sur le terrain, selon lesquelles elle serait florissante (Chapdelaine, Dupuis *et al.*, présente publication).

7.6. Atlantique □

Cette population montrait aucune divergence importante, ce qui concorde avec les données recueillies sur le terrain, selon lesquelles la plupart des effectifs sont stables ou à la hausse (Mendall, 1968; Cannell et Maddox, 1983; Erskine et Smith, présente publication).

7.7. Quelques considérations écologiques □

L'utilisation du modèle de population a fait ressortir jusqu'à quel point les trois sous-espèces d'Eider à duvet de l'est du Canada (*S.m. dresseri*, *S.m. borealis* et *S.m. sedentaria*) se retrouvent en contact étroit pendant l'été, et combien certaines haltes migratoires et stations d'hivernage des deux premières sous-espèces débordent les unes sur les autres. Il y a lieu de croire que les migrations de *S.m. borealis* à destination du sud-ouest du Groenland sont aussi l'occasion de contacts avec la sous-espèce islandaise (*S.m. islandica*). C'est ce qui explique l'existence de formes intermédiaires, notamment entre le *S.m. dresseri* et le *S.m. borealis* (Mendall, 1980 et présente publication). Il est même surprenant que les formes intermédiaires soient si peu répandues, situation qui indiquerait une tendance prononcée à l'homogamie.

Il est permis de croire qu'antérieurement les trois sous-espèces de l'est de l'Amérique du Nord occupaient des aires distinctes. Durant la pleistocène, le *S.m. dresseri* occupait, peut-être, la côte Atlantique au sud des glaciers, et le *S.m. borealis* un refuge climatique quelque part dans l'Arctique, peut-être près de la baie de Baffin. Mais le *S.m. sedentaria* doit avoir évolué depuis le dernier recul des glaciers, puisque la baie d'Hudson était couverte de glaces avant cette date; des ressemblances au point de vue de la taille et de la forme du bec laissent supposer qu'elle est issue d'une population de *S.m. dresseri*. La baie d'Hudson aurait pu être envahie par des *S.m. dresseri* à travers les terres séparant la mer de Tyrrell (baie d'Hudson) et la mer Champlain (golfe du Saint-Laurent) (voir Shilts, 1982; Prest *et al.*, 1970); à mesure que le réchauffement du climat permettait à certaines nappes d'eau de demeurer libres de glaces à l'année, et que le rebondissement du continent élargissait la barrière terrestre, le groupe est devenu sédentaire, perdant contact avec la côte Atlantique (voir aussi Todd, 1963 et Snyder, 1941).

Il est généralement présumé que le *S.m. sedentaria* demeure à l'intérieur de la baie d'Hudson toute l'année (Palmer, 1976). Des observations (voir Prach *et al.*, 1981; Abraham et Finney, présente publication) et des enquêtes sur les prises (annexes 1 et 2) montrent la présence d'Eiders à duvet dans la baie d'Hudson chaque mois de l'année, mais il n'a pas été démontré que l'ensemble de la population de *S.m. sedentaria* y demeure tout l'hiver. Il est difficile de comprendre comment, durant l'hiver, quand l'étendue des champs de glaces est énorme (Stirling 1981, figure 1), une si grande population pourrait s'héberger à l'intérieur de la baie (tout en étant observée par si peu d'observateurs ornithologiques). Il est possible qu'un certain nombre migre jusqu'au détroit d'Hudson ou la côte du Labrador, ou encore plus au sud, mais aucune preuve n'a été obtenue. Deux morts accidentelles (H. Ouellet, comm. pers.) et la recapture d'un individu bagué de cette sous-espèce dans le centre-sud du Canada depuis quelques dizaines d'années ne sauraient être que des épisodes inusités, qui peuvent avoir été provoqués par les glaces à la faveur d'une saison exceptionnellement rigoureuse.

En général, le *S.m. dresseri* émigre vers le sud et la majorité de la population hiverne près de la limite méridionale de son aire de nidification. Quelques individus hivernent cependant bien en deçà de cette limite, sur la rive nord du golfe du Saint-Laurent. Le gros des effectifs de *S.m. borealis* émigrent au delà de la frontière méridionale de l'aire de nidification du troupeau; ceux qui s'en détachent restent dans le détroit d'Hudson et dans le sud-ouest du Groenland. Les groupes qui nichent dans la partie la plus septentrionale de l'aire de distribution de chacune de ces deux sous-espèces sont généralement celles qui émigrent le plus loin, mais elles hivernent néanmoins plus au nord que les colonies parties du sud de l'aire de nidification. On a constaté le même phénomène dans le cas des populations de *S.m. borealis* en provenance du Groenland (Salomonsen, 1967).

Deux importantes aires d'hivernage, Anticosti/Mingan et Nouvelle-Écosse/Nouvelle-Angleterre, sont aussi d'importantes aires de reproduction. Un territoire très fréquenté durant l'hiver ne devient donc pas pour autant inutilisable pour la nidification, peut-être parce que les besoins alimentaires varient selon les saisons : gros bivalves et oursins pendant l'hivernage, puis oeufs de poisson, crustacés et petits gastéropodes pendant la nidification et l'élevage de la couvée (Cantin *et al.*, 1974). Durant la mue, les mâles ont probablement besoin d'un régime semblable à celui des femelles reproductrices et des canetons (Pethon, 1968), c'est possible que leur migration de mue diminue la pression exercée sur les ressources alimentaires de l'aire de nidification (Salomonsen, 1968). Malheureusement, nos connaissances sur les migrations de mue et les aires de mue sont assez fragmentaires, à l'exception de l'information fournie par les Inuit de la baie d'Ungava (Nakashima, présente publication).

8. Conclusions à tirer pour la gestion et la conservation

La principale utilité de notre étude est de signaler les besoins que devraient combler les recherches futures (il en est question à la section suivante), mais certains résultats intéressent les gestionnaires de façon immédiate.

À l'heure actuelle, on peut reconnaître quatre grandes aires de nidification : celle du détroit d'Hudson (incluant le nord du Labrador, la baie d'Ungava, le détroit de Cumberland et l'est de l'île Southampton) où nichent plus de 90 000 couples reproducteurs de *S.m. borealis*, soit environ 98 % de tout l'effectif estimé de cette sous-espèce au Canada (Abraham et Finney, présente publication); celle de l'est de la baie d'Hudson (incluant la côte québécoise et les îles Belcher), où nichent plus de 20 000 couples reproducteurs de *S.m. sedentaria*, soit environ 92 % des effectifs de cette sous-espèce (*ibid.*); l'estuaire du Saint-Laurent, qui compte 18 500 couples reproducteurs de *S.m. dresseri*, soit presque 30 % de la population totale (Chapdelaine, Dupuis *et al.*, présente publication); et la zone de l'Atlantique (principalement la rive orientale de la Nouvelle-Écosse et la côte du Maine), qui compte environ 37 500 couples de *S.m. dresseri*, soit 58 % du total. Dans chacun de ces territoires, il y a lieu d'accorder une attention spéciale à la protection de l'habitat. La menace que la villégiature et le développement portuaire représentaient jusqu'à tout récemment pour de nombreuses colonies de l'estuaire du Saint-Laurent est maintenant beaucoup moins grande parce que le Service canadien de la faune a acquis le contrôle des activités sur plusieurs îles stratégiques, et que des organismes de conservation privés sont devenus propriétaires d'autres sites. Mais là, comme dans la zone de l'Atlantique et dans le détroit d'Hudson, les aires de gagnage maritimes demeurent exposées à la dégradation par les déversements d'hydrocarbures et d'autres polluants.

L'aire de nidification du golfe du Saint-Laurent (incluant la Côte-Nord, Terre-Neuve et le sud du Labrador) abrite actuellement moins de 10 000 couples de *S.m. borealis* (Chapdelaine *et al.*, présente publication; Lock, présente publication). Une population beaucoup plus nombreuse pourrait sans doute y nicher, toutefois, si l'on mettait en vigueur des mesures plus rigoureuses pour en freiner la surexploitation.

Trois aires d'hivernage se révèlent d'une importance majeure : la côte orientale de Terre-Neuve, où la population hivernante est probablement de l'ordre de 150 000 individus, en majorité des *S.m. borealis*; l'aire d'hivernage Anticosti–Mingan dans le golfe du Saint-Laurent, où les groupes de *S.m. borealis* et de *S.m. dresseri* comptent environ 150 000 individus au total; et la région de l'Atlantique (incluant les côtes méridionales de la Nouvelle-Écosse et le littoral du Maine et du Massachusetts), où la population (surtout composée de *S.m. dresseri*) dépasse 180 000 individus en hiver (Bourget *et al.*, présente publication). La vigilance s'impose dans ces trois secteurs, où il y a risque de pollution par déversement d'hydrocarbures. La chasse illégale au printemps et à la fin de l'hiver est pratique courante sur les rives nord et ouest du golfe et sur les côtes de Terre-Neuve; les traditions bien enracinées de la chasse printanière ont la vie dure dans ces régions isolées, mais on a lieu d'être optimiste, maintenant que l'île d'Anticosti est devenue un parc provincial, que l'établissement du parc national de l'archipel de Mingan est imminent et que l'on voit récompensés dans maintes localités de la Côte-Nord les efforts déployés pour gagner des adeptes à la cause de la conservation (Blanchard, 1984).

9. Propositions de recherche plus approfondie

Notre modèle de population est le fruit d'un premier effort visant à mesurer l'incidence de la chasse sur diverses populations d'Eider à duvet de l'est de l'Amérique du Nord. Pour en faire un outil que les gestionnaires pourraient utiliser en toute confiance, il faudrait multiplier encore les relevés de nids, les enquêtes sur les prises, les inventaires d'hiver et les opérations de baguage. Il faudrait également déterminer de quelles sous-espèces se composent les prises et les rassemblements d'hiver dans des régions données, et d'amplifier les efforts pour étudier l'histoire naturelle des populations. Il est en outre nécessaire de chercher à établir l'importance relative des diverses formes d'exploitation sur les niveaux de population.

9.1. Relevés de nids □

Nous possédons des relevés d'une précision acceptable pour toute l'aire de dispersion des *S.m. dresseri* et celle des *S.m. borealis* située dans la baie d'Ungava et dans le nord du Labrador. Grâce à des recensements subséquents faits à intervalles réguliers, nous pourrons déceler, le cas échéant, toute tendance démographique importante. À cause du nombre d'eiders qui y nichent, le reste de l'aire de dispersion de la population du Bas-Arctique mérite qu'on y poursuive les relevés; la côte sud de l'île de Baffin devrait être recensée en détail, et il serait utile de faire des relevés exploratoires du bassin Foxe, de l'île Southampton et du centre-est de l'île de Baffin. Il est hors de question d'effectuer des relevés exhaustifs dans le Haut-Arctique où les frais logistiques sont élevés et la population dispersée en petites colonies éloignées les unes des autres, mais rien n'interdit de profiter d'autres missions sur le terrain pour recueillir aussi des données utiles. Il est urgent de recenser les nids d'Eider à duvet de la baie d'Hudson; cette population devrait faire l'objet de relevés détaillés le long de la rive québécoise de la baie et aux alentours des îles Belcher, et il faudrait étendre la couverture des recensements le long des rives sud et ouest.

9.2. Enquêtes sur les prises □

Le raffinement des enquêtes sur les prises de chasse sportive effectuées dans le sud du Canada et aux États-Unis laisse beaucoup à désirer; il est extrêmement important qu'on arrive à éliminer les divergences entre les résultats des Enquêtes nationales sur les prises et ceux des Enquêtes spéciales sur les canards de mer (voir Wendt et Silieff, présente publication). Il faudrait que les enquêtes sur les prises des autochtones soient répétées, au moins à intervalles réguliers, dans tout le Nord québécois, et qu'on modifie les questionnaires pour que les résultats tiennent compte séparément de l'Eider remarquable (*S. spectabilis*) et de l'Eider à duvet (*S. mollissima*). Dans la région de l'île de Baffin, on devrait prévoir la poursuite de l'enquête sur les prises à intervalles déterminés. Il est important d'obtenir des estimations sur le nombre de prises des communautés autochtones du sud et de l'ouest de la baie d'Hudson et dans l'île Southampton.

9.3. Enquêtes hivernales □

Il est difficile d'estimer avec exactitude la population des quartiers d'hivernage, car les oiseaux stationnent loin des rives rendant leur détection difficile. Il est dangereux pour les observateurs de survoler l'eau libre en hiver et l'estimation visuelle des grands rassemblements est sujette à des erreurs appréciables. La tâche est encore plus compliquée lorsqu'il faut distinguer l'Eider remarquable de l'Eider à duvet, particulièrement dans le détroit d'Hudson et le Groenland.

En dépit de ces inconvénients, il serait utile de chercher à perfectionner les techniques d'inventaire hivernal (voir Bourget *et al.*, présente publication), car une méthode raffinée pourrait nous procurer des données essentielles sur les tendances démographiques générales si on l'appliquait aux trois grandes concentrations d'oiseaux qui hivernent au large du littoral est du continent nord-américain : Terre-Neuve, Anticosti/Mingan et Nouvelle-Écosse/Nouvelle-Angleterre. Il est important que l'on procède à des recensements exploratoires pour établir la distribution et l'abondance des *S.m. sedentaria* dans la baie d'Hudson et dans le détroit de Roes Welcome.

9.4. Baguage □

Il faudrait baguer un nombre beaucoup plus considérable d'individus pour établir plus facilement l'itinéraire que suivent les diverses populations lorsqu'elles gagnent leurs aires d'hivernage respectives et pour évaluer l'incidence de la chasse sur ces populations. Bien qu'on ait bagué un nombre substantiel d'eiders dans l'estuaire du Saint-Laurent, sur le littoral est de la Nouvelle-Écosse et dans le Maine, la plupart sont des femelles adultes, ce qui donne une image incomplète des itinéraires et des calendriers de migration. En raison de la migration de mue des mâles adultes (Salomonsen, 1968), leur distribution est sans doute très différente de celle des femelles adultes et des jeunes à la fin de l'été et à l'automne. Les juvéniles sont probablement dispersés sur un plus vaste territoire que les adultes en hiver (Wakeley, 1973). Le baguage de cohortes de mâles adultes et de juvéniles serait d'une grande utilité dans les trois zones de nidification mentionnées ci-dessus. Dans toutes les autres aires de nidification importantes, il faudrait étendre le baguage à toutes les cohortes. Les populations désignées où il serait le plus urgent de procéder au baguage sont celles du Bas-Arctique et du golfe du Saint-Laurent et, en second lieu, celles du Haut-Arctique et de la baie d'Hudson.

9.5. Détermination de la composition sous-spécifique des prises et les populations hivernantes □

Si l'on savait l'importance relative des sous-espèces qui composent les populations dénombrées aux haltes migratoires et aux lieux d'hivernage, on pourrait mieux suivre l'itinéraire de chaque population et la contribution de chacune aux prises régionales. Il est malheureusement impossible d'identifier les sous-espèces à partir des ailes envoyées par les chasseurs qui participent aux Enquêtes nationales sur la composition des prises. Les critères d'identification proposés par Mendall (présente publication) remédient à cette situation, à condition qu'on puisse obtenir les têtes ou les carcasses entières. L'application de cette technique à l'occasion de l'inspection des prises individuelles nous fournirait de précieux renseignements, notamment si l'on y procédait dans des régions où les prises y sont importantes comme Terre-Neuve, le golfe du Saint-Laurent et la région de la Nouvelle-Écosse/Nouvelle-Angleterre.

9.6. Incidence des diverses formes de prélèvement □

Certaines des populations désignées font l'objet de prises lors de la chasse 12 mois par année, et on ramasse leurs oeufs et leur duvet pendant les mois d'été. Afin d'assurer une exploitation judicieuse de ces populations, il est important de déterminer l'incidence relative de chaque forme de prélèvement de même que l'effet global de tous ces prélèvements combinés sur les populations. Dans quelle mesure la chasse printanière a-t-elle une plus grande incidence que celle de l'automne? Une réduction des prises printanières par des chasseurs de subsistance permettrait-elle une augmentation suffisante des prises pour satisfaire à leurs besoins? Les besoins printaniers de ces mêmes chasseurs pourraient-ils être comblés par une autre source de nourriture, et sinon, est-il avantageux de réduire la prise d'eiders adultes en faveur d'un plus grand ramassage des oeufs? Pour répondre à ces questions et à d'autres qui s'y rattachent, il faudra accroître le baguage et les enquêtes sur les prises, et pousser plus loin les recherches sur le terrain du genre de celles dont Cooch fait état dans la présente publication.

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Appendix 1

Harvest of eiders in the Baffin region 1982

Area	Total annual harvest		Estimated harvest											
	Reported	Estimated	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
High Arctic														
Resolute Bay	36	53	0	0	0	0	0	0	37	16	0	0	0	0
Arctic Bay	105	123	0	0	0	0	0	15	5	11	21	1	0	0
Nanisivik	55	71	0	0	0	0	0	4	0	7	57	3	0	0
Grise Fiord	274	281	0	0	0	0	7	26	55	28	147	0	0	0
Pond Inlet	24	26	0	0	0	0	2	2	5	13	2	0	0	0
Low Arctic														
Broughton Island	341	356	0	0	0	0	15	29	55	55	85	99	13	0
Clyde River	295	301	0	0	0	0	30	27	7	21	86	120	1	0
Pangnirtung	2034	2300	1	0	0	2	5	508	266	20	581	911	0	0
Frobisher Bay	293	370	0	0	0	0	9	25	27	63	140	88	0	0
Lake Harbour	615	760	0	0	0	2	25	115	165	25	146	187	93	5
Cape Dorset	2443	3470	16	4	4	392	548	877	932	196	288	305	51	0
Hall Beach	214	230	0	0	0	0	6	170	43	2	9	0	0	0
Igloolik	150	280	0	0	0	0	0	22	9	15	6	0	0	0
Belcher Islands														
Sanikiluaq	3821	6000	64	681	17	5	389	633	724	457	360	958	1368	344

SOURCE: Data from J. L. Donaldson (1984 and pers. commun. Aug. 83, Jan. 84).

Appendix 2

Harvest of eiders in northern Quebec, 1979–80

	Estimated annual kill		April			May			June			July			Apr.–July total		
	1979	1980	1979	1980	Mean	1979	1980	Mean	1979	1980	Mean	1979	1980	Mean	1979	1980	Mean
Hudson Strait and Ungava Bay																	
Kuujjuaraapik and Chisasibi	1030	1835	0	6	3.0	45	9	27.0	110	152	131.0	185	108	146.5	340	275	307.5
Inukjuak	4320	4617	60	190	125.0	570	656	613.0	1253	1057	155.0	562	586	574.0	2445	2489	2467
Akulivik	986	900	6	22	14.0	85	78	81.5	222	212	217.0	147	60	103.5	460	372	416
Hudson Bay																	
Salluit	953	564	0	0	0	11	3	7.0	64	25	44.5	132	45	88.5	207	73	140
Kangiqsujuaq	561	576	0	0	0	78	32	55.0	125	140	132.5	163	247	205.0	366	419	392.5
Quaqtaq	203	277	0	0	0	11	0	5.5	9	54	31.5	3	16	9.5	23	70	46.5
Kangiqsuk	359	275	0	4	2.0	0	5	2.5	50	28	39.0	48	41	44.5	98	78	88
Aupaluk	109	143	0	0	0	0	0	0	38	22	30.0	47	56	51.5	85	78	81.5
Tasiujaq	378	403	0	0	0	2	0	1.0	207	297	252.0	104	28	66.0	313	325	319
Kuujjuaq	436	412	0	0	0	12	31	21.5	198	140	169.0	112	86	99.0	322	257	289.5
Kangiqsualujjuaq	574	352	0	0	0	0	5	2.5	179	87	133.0	197	186	191.5	376	278	327

NOTE: Data from JBNQNHRC 1982. Monthly breakdowns based on percent derived from "reported" kills by month as provided by L. Brooke, JBNQNHRC, December 1983.

	Aug.			Sep.			Oct.			Nov.			Dec.		
	1979	1980	Mean	1979	1980	Mean	1979	1980	Mean	1979	1980	Mean	1979	1980	Mean
Hudson Strait and Ungava Bay															
Kuujjuaraapik and Chisasibi	82	92	87	12	62	37	235	578	407	310	672	491	83	160	122
Inukjuak	367	360	364	406	476	441	514	660	587	341	392	366	39	134	87
Akulivik	92	73	83	241	139	190	92	167	130	8	12	10	21	41	31
Hudson Bay															
Salluit	69	5	37	116	268	192	146	142	144	414	76	245	0	0	0
Kangiqsujuaq	29	18	24	39	89	64	72	37	55	13	0	7	15	13	14
Quaqtaq	0	0	0	81	6	74	90	142	116	7	0	4	0	0	0
Kangiqsuk	59	42	51	94	99	97	103	46	75	5	0	3	0	0	0
Aupaluk	18	3	11	4	21	13	1	41	21	0	0	0	0	0	0
Tasiujaq	15	29	22	27	47	37	22	1	12	1	0	1	0	0	0
Kuujjuaq	34	100	67	52	24	38	28	31	30	0	0	0	0	0	0
Kangiqsualujjuaq	91	11	51	82	46	64	25	16	21	0	1	1	0	0	0

	Jan.			Sep.–Jan. total			Feb.			March		
	1979	1980	Mean	1979	1980	Mean	1979	1980	Mean	1979	1980	Mean
Hudson Strait and Ungava Bay												
Kuujjuaraapik and Chisasibi	28	0	14	640	0	0	0	1472	1056	13	0	7
Inukjuak	22	92	57	1434	134	5	70	1667	1551	48	14	31
Akulivik	55	81	68	382	20	16	18	375	379	0	0	0
Hudson Bay												
Salluit	0	0	0	0	0	0	676	486	581	0	0	0
Kangiqsujuaq	12	0	6	15	0	8	154	139	147	0	0	0
Quaqtaq	12	0	6	0	0	0	178	208	193	0	0	0
Kangiqsuk	0	11	6	0	0	0	202	145	174	0	0	0
Aupaluk	0	0	0	0	0	0	5	62	34	0	0	0
Tasiujaq	0	0	0	0	0	0	50	48	49	0	0	0
Kuujjuaq	0	0	0	0	0	0	80	55	68	0	0	0
Kangiqsualujjuaq	0	0	0	0	0	0	107	63	85	0	0	0

Appendix 3
A description of the methods used to construct the population model

1. Establish the size of eider populations on 1 Sep. □

The early fall population comprises three cohorts: sexually mature adults, subadults (yearlings and 2 year olds; Baillie and Milne 1982); and young-of-the-year.

The *adult cohort* represents the number of breeding individuals.

The *young-of-the-year cohort* is established by applying an estimated rate of production of fledged young to the number of breeders. Milne and Reed (1974) established that each breeding pair produced 0.31 fledged young in the St. Lawrence estuary and 0.26 in Scotland. McAloney's (1973) data for eastern Nova Scotia suggested a rate of 0.50 per pair. Swennen (1983) reported 0.47 for *S.m. mollissima* in the Netherlands, and Hildén (1964) 0.89 in Finland. A rate of 0.60/pr. was arbitrarily chosen here; it is somewhat higher than the values shown in Canadian and Scottish studies, but allows for reductions in measured productivity resulting from intensive study (i.e., investigator disturbance).

The *subadult cohort* represents the survivors of the 60 fledged young (60 per 100 pairs) from each of the two previous years. Their survival rates are not known but their numbers can be derived indirectly from the knowledge that the 2-year-old cohort would have to number at least 30 (15 pairs) to replace the annual loss of adult breeders, which is taken as 15% (rates of 17 and 12% have been calculated for adult females by Reed 1975, and Cooch, this publication, respectively). That replacement could be achieved as follows:

Yearlings: 60 fledged young from year y-1 @ assumed ann. survival of 65% = 39
2 yr-olds: 39 survivors from young, year y-2 @ assumed ann. survival of 80% = 31 (approximating the 30 required for population balance)

Thus approximately 39 + 31 = 70 subadults are present in August, as well as the 200 breeding adults and 60 fledged young for a total of 330; a multiplication factor of 3.3 is therefore applied to the number of breeding pairs, or 1.65 per adult breeder, to derive the fall flights. A correction is required for northern breeding units to account for birds killed during August. The estimates are established as shown in Table 1.

Table 1
Estimating sizes of fall flights of Common Eiders

Population group	No. of breeding individuals		Multiply by 1.65 = initial fall flight*	Subtract August kill	Final estimate of fall flight*
High Arctic	2355 + 40 (north Baffin) from Table 4, Abraham and Finney† = 2395 rounded upwards to include Somerset Island = 2400		3 960	75	3 890
Low Arctic	Table 4 in Abraham and Finney for east and south Baffin, north Labrador, Foxe Basin and Southampton Island and northern Quebec = 183 000‡		301 950	760	301 190
Hudson Bay	Table 3 in Abraham and Finney = 45 165		74 520	1200	73 320
Gulf of St. Lawrence	Quebec (Chapdelaine, Dupuis, *et al.*)	10 760			
	Labrador (Lock)	6 300§			
	Newfoundland (4–500 prs? Lock)	900			
	New Brunswick (Chaleur Bay) (Table 3 in Erskine and Smith)	300			
	Rounded total	18 300	30 200	tr.	30 200
St. Lawrence Estuary	Chapdelaine, Dupuis *et. al.*	36 900	60 890	nil	60 890
Atlantic	NS and NB (less Chaleur Bay) (Table 3 in Erskine and Smith)	30 000			
	Maine (Spencer *et al.* 1982)	44 800			
	Total	74 800	123 420	nil	123 420
Total					592 910

* Rounded, to nearest 10.
† All citations in this table are to other papers in this publication, unless a date is given.
‡ Includes approximately 21 700 individuals from Labrador (more than indicated by Abraham and Finney) to include intergrades as well as *borealis* in this group.
§ The assumed number of "pure" *dresseri* in the population of 28 000 in Labrador (Lock).

2. Establish distribution of harvest from St. Lawrence estuary group □

The distribution of kill of adult female Common Eiders from the St. Lawrence estuary banded during 1951–75, and recovered in September–February up to 1981, is as follows:

Gulf and that part of estuary north of 48°N	32	21%
Estuary up to and including 48°N	53	34%
Atlantic	71	45%
Total	156	

All band recoveries due to hunting that occurred in the estuary were from locally breeding birds.

Wendt and Silieff (this publication) estimated that 2327 eiders are shot annually in the legal sport hunt in the estuary (see App. 4). Therefore, if 2327 represents 34% of the harvest from the local population, then the 21% harvested in the gulf equals 1437 and the 45% in the Atlantic wintering area equals 3080.

3. Establish size of kill of Atlantic population group □

According to banding data all are killed in the Atlantic area: the harvest rate is assumed to be 15% because the local birds are present throughout a long season, sea-duck hunting is popular, and bag limits are generous: 0.15 × 123 420 = 18 513

4. Establish size of contribution of the Low Arctic group to Atlantic area kill □

Mendall (1980) indicated 6% of eiders overwintering in Maine are either *S.m. borealis* or intergrades between *borealis* and *dresseri*. Assuming that this proportion holds for the total region, and that no significant numbers of *borealis* from the High Arctic group come that far south, 6% of the total kill in the Atlantic area would come from the Low Arctic population.

The total harvest in the Atlantic region = 30 046 (see App. 4).
Part of that kill coming from the Low Arctic population = 0.06 × 30 046 = 1803

5. Establish contribution of Gulf of St. Lawrence group to kill in Atlantic area □

Total harvest	= 30 046
Subtract kill in Low Arctic (from step 4)	1 803
Subtract kill in St. Lawrence estuary (from step 2)	3 080
Subtract kill in Atlantic population group (from step 3)	18 513
Leaving kill in the Gulf of St. Lawrence	6 650

6. Establish contribution of Gulf of St. Lawrence group to kill in other areas □

The meagre banding data, available only for the south Labrador segment of this population, suggest that 60% of the harvest is taken in southern Labrador and Newfoundland, 10% in the Gulf of St. Lawrence, and 30% in the Atlantic area. However, the segment of the population from the north shore of the Gulf of St. Lawrence in Quebec probably has a different harvest distribution, supplying few birds to Newfoundland and Labrador, moderate numbers to the kill in the estuary, and most to the Atlantic area; we have assumed proportions of 10%, 35%, and 55%, respectively. Those values when weighted and combined with the southern Labrador ones suggest an overall distribution of the Gulf of St. Lawrence population's harvest of 30% in Newfoundland and Labrador, 25% in the gulf proper, and 45% in the Atlantic area.

If 45% of that harvest represents 6650 eiders (see step 5), then the harvest occurring in the gulf (25%) is 3694 and in Newfoundland and Labrador (30%) 4433.

7. Establish contribution of Low Arctic group to the kill in the Gulf of St. Lawrence □

Total kill in gulf	(see App. 4)	= 7991
Subtract kill from estuary group	(see step 2)	1437
Subtract kill from gulf group	(see step 6)	3694
Remaining portion of kill attributable to Low Arctic group		2860

8. Establish contribution of Low Arctic group to kill in the Newfoundland–Labrador area □

Total kill	(see App. 4)	= 28 054
Subtract harvest from gulf group	(see step 6)	4 433
Remaining portion of kill attributable to Low Arctic group		23 621

9. Establish size of surviving fall flight from Low Arctic group that remains to overwinter in that same area □

An estimated 4000 Common Eiders overwinter in the area (Abraham and Finney, this publication) composed of locally-produced birds as well as some from the High Arctic group.

In a subsequent step (#17) it is established that approximately 1510 eiders from the High Arctic group overwinter near the mouth of Hudson Strait. By subtraction: 4000 − 1510 = 2490 Common Eiders from the Low Arctic group remain there to winter.

10. Establish the number of eiders from the Low Arctic group killed by natives during September–January in the same area □

The kill can be subdivided into four geographical units (App. 1 and 2):
a) The Quebec communities of Hudson Strait and Ungava Bay (Salluit eastward to Kangiqsualujjuak) where mean estimated kills (1979–80) totalled 1336 for the September–January period and can be expected to come entirely from the Low Arctic group.
b) The Baffin Region communities of Cape Dorset, Hall Beach, and Igloolik whose 1982 estimated kills of 675 come entirely from the Low Arctic group.
c) The Baffin region communities of east and southeast Baffin (Broughton Island, Clyde River, Pangnirtung, Frobisher Bay, and Lake Harbour) whose 1982 estimated harvest of 2556 probably contains birds from both the Low Arctic and High Arctic groups: approximately 2235 of them are considered to come from the Low Arctic group.
d) Other communities such as Coral Harbor and Ivujivik for which kill estimates are not available. A value of 500 is used here.
Total = 4746 rounded to 4750 eiders.

11. Establish the native September–January kill from the High Arctic group occurring in the same area (App. 1 and 2) □

Limited to the estimated kill (1982) from Resolute Bay, Arctic Bay, Nanisivik, Grise Fiord, and Pond Inlet = 231 eiders, rounded to 230.

12. Establish the number killed of that segment of the High Arctic group that migrates to Greenland □

The assumption is made that those that survive the regional hunt divide equally into Greenland and Hudson Strait wintering segments.

Fall flight of	3890 birds
Subtract local harvest (see step 11)	230
Survivors	3660
÷ 2 =	1830 (Fall flight moving to Greenland)

Salomonsen (1967) reported a kill rate of 22% for west Greenland *borealis* eiders. It is probable that the Canadian birds that join them suffer a lesser rate because they may be available to Greenland hunters for a shorter period and may winter somewhat to the north of the main hunting area. A value of 20% is used here and it is assumed that half of that kill occurs prior to 31 January, the remainder in February–May.

Harvest of birds from High Arctic group is therefore 20% of 1830 = 366, with 183 occurring during September–January.

13. Establish the number of birds from the High Arctic group killed by natives in September–January in the Hudson Strait area □

This harvest is considered to be part of the kill reported for the communities of southeast Baffin Island (see part 10*c* of this appendix and App. 1). Approximately 320 are considered to come from the High Arctic group.

14. Establish the number of Hudson Bay eiders killed by natives in September–January □

The harvest is assumed to occur entirely within Hudson Bay, subdivided geographically as follows:
a) Belcher Islands area where the Baffin Region harvest study shows a 1982 estimated kill of 3094, rounded to 3100 (App. 1).

b) The Quebec communities of Kuujjuaraapik, Inukjuak, and Akulivik whose mean (1979–80) harvest totalled 2986, rounded to 3000 (App. 2).
c) The Quebec communities of Ivujivik and Povungnituk and other localities in southern and western Hudson Bay for which there are no data; a value of 1600 is used here.
Total = 7700 eiders

15. Establish the late January population of Hudson Bay Eiders □

The estimated fall flight (see step 1)	73 320 birds
Subtract local harvest (see step 14)	7 700
	65 620

16. Establish the size of the late January population of High Arctic Canadian birds wintering in Greenland □

Fall flight reaching Greenland (see step 12)	1830
Subtract eiders killed in September–January in Greenland (see step 12)	183
	1647

17. Establish that segment of the late January population wintering in Hudson Strait that originates from the High Arctic group □

The fall flight that reaches Hudson Strait (see step 12)	1830
Subtract Hudson Strait harvest (see step 13)	320
Contribution of High Arctic group to Hudson Strait	1510

18. Establish the late January population overwintering in the Newfoundland–Labrador, the St. Lawrence Gulf, and the Atlantic wintering areas □

From Bourget *et.al.* (this publication)	in Newfoundland–Labrador	= 152 200
	in the gulf	= 154 500
	in Atlantic	= 185 700
		492 400

An independent estimate of the total can be made by totalling the fall flights from those units supplying birds to those wintering areas, and then subtracting the numbers that have been killed or have migrated to other wintering areas:

Total fall flights 301 190 + 30 200 + 60 890 + 123 420 =	515 700
Subtract eiders killed 4750 + 28 054 + 7991 + 30 046 + 2327 =	73 168
Subtract eiders migrated to other winter areas (see step 9)	2 490
	440 042

The two estimates are within 10% of each other.

19. Establish February–May kill of Hudson Bay eiders, and survivors at end of May □

Total kill for three Quebec communities (mean 1979–80) Kuujjuaraapik, Inukjuak, Akulivik (App. 2)	= 1040
Total kill for Belcher Islands (App. 1)	= 1090
Total kill for communities of Ivujivik and Povungnituk and others in southern and western Hudson Bay; not known, taken as	1000
Total	3130
(Winter population (see step 15)	= 65 620
Subtract	3 130
Survivors	62 490

20. Establish February–May eider kill from High Arctic group, and survivors at end of May □

The Greenland wintering component is reduced by 183 (see step 12) from a wintering population of 1647 (see step 6) and therefore returns 1464 survivors.
The Hudson Strait wintering component of 1510 birds (see step 17) suffers a harvest of 31 (total estimated 1982 harvest from Arctic Bay, Nanisivik, Grise Fiord, and Pond Inlet = 9; plus an assumed 25% of kill of 89 birds in Broughton Island, Clyde River, Pangnirtung, Frobisher Bay, and Lake Harbour = 22: Appendix 1, yielding 1479 survivors.
Total losses = 183 + 31 = 214
Total survivors = 1464 + 1479 = 2943

21. Establish the February–May eider kill of the Low Arctic group, and survivors at end of May □

a) It is assumed that 75% of harvest in Broughton Island, Clyde River, Pangnirtung, Frobisher Bay, and Lake Harbour is made up of birds from this population = 0.75 × 89	(App. 1) = 67
b) Quebec communities of Hudson Strait and Ungava Bay show a total harvest of	(App. 2) = 234
c) Communities of Cape Dorset, Hall Beach, and Igloolik show a total harvest of	(App. 1) = 954
d) For other communities such as Coral Harbour and Ivujivik the harvest is unknown; taken as	100
Total native harvest	1 355
e) The February–March hunt in Newfoundland–Labrador yielded an estimated kill (from Wendt and Silieff, this publication)	(App. 4) 12 370
f) An illegal kill occurs in April–May in the Gulf, Labrador, and Newfoundland, the size of which is unknown; taken as	2 000
Total harvest is	15 725

The 1 September fall flight of	301 190 birds
has suffered the following losses (see step 10)	4 750
(see step 8)	23 621
(see step 7)	2 860
(see step 4)	1 803
see above	15 725
by subtraction, the number of survivors	= 252 431

22. Establish the number of eiders surviving from the Gulf of St. Lawrence group, at end of May □

The 1 September fall flight of	30 200
has suffered sport hunting losses of (see step 6)	4 433
(see step 6)	3 694
(see step 5)	6 650
Plus illegal harvest in gulf and Newfoundland–Labrador in April–May; unknown but taken as	800
by subtraction, the number of survivors	= 14 623

23. Establish the number of eiders surviving from the St. Lawrence estuary group at end of May □

The 1 September fall flight of	60 890
has suffered losses of (see step 2)	1 437
(see step 2)	2 327
(see step 2)	3 080
plus (April–May) illegal kill in gulf, taken as	100
by subtraction, no. survivors	= 53 946

24. Establish the number of eiders surviving from the Atlantic population group at end of May □

The 1 September fall flight of	123 420
suffered a loss of (see step 3)	18 513
by subtraction	104 907

25. Establish losses occurring between arrival on nesting grounds and hatching of eggs, and survivors just prior to hatch □

a) Hudson Bay population group:

From a 1 June population of (see step 19)		62 490
subtract harvests (June and July) from:		
three Quebec communities on Hudson Bay (App. 2)	2328	4 485
Belcher Islands (App. 1)	1357	
Other communities taken as	800	
Survivors		58 005

b) High Arctic population group:

From a 1 June population of (see #20)	2943
subtract June and July harvests from High Arctic communities (App. 1)	149
Survivors	2794

c) Low Arctic population group:

From a 1 June population of (see step 21)		252 431
Subtract June and July harvest:		
Quebec communities of Hudson Strait (App. 2)	1591	−5 368
Baffin reg. communities of Hudson Strait, Foxe Basin, Cumberland Sound (App. 1)	3277	
Other communities; taken as	500	
Survivors		247 063

d) Gulf of St. Lawrence population group:

From a 1 June population of (see #22)	14 623
Subtract an illegal spring harvest, taken as	200
Survivors	14 423

e) St. Lawrence Estuary population group:
With a negligible breeding season kill, the 1 June population of 53 946 (see step 23) remains the same through to hatch.

f) Atlantic population group:
With a negligible kill, population remains unchanged at 104 907 (see step 24).

26. Establish the size of the population at time of fledging of the young (August) and on 1 September □

The population will be composed of the survivors just prior to hatch (approximately 1 June), plus the current year's production of ducklings. The production of ducklings is a function of the number of sexually mature adults among the 1 June survivors. The population of sexually mature eiders can be derived from the hypothetical age breakdown provided in step 1. Excluding the newly fledged young yields a late summer population of 270 birds, of which 200 (74%) are sexually mature. They would produce young at the rate of 0.30 (half the rate of 0.60 which applies to pairs rather than individuals).

Let the number of 1 June survivors = X
Then the Aug. population would be
$X + 0.74\,(0.30)\,X = 1.22X$

	Survivors at hatch (see step 25)	Population at fledging (× 1.22)	Subtract Aug. harvest	Population on 1 Sep.
Hudson Bay	58 005	70 766	1200	69 566
High Arctic	2 794	3 409	75	3 334
Low Arctic	247 063	301 417	760	300 657
Gulf of St. Lawrence	14 423	17 596	tr.	17 596
St. Lawrence estuary	53 946	65 814	nil	65 814
Atlantic	104 907	127 987	nil	127 987
				584 954

Appendix 4
Common Eider sport hunting kill, by province, also summarized by region of kill. Newfoundland–Labrador data by season

Common Eider hunting kill from Table 3 in Wendt and Silieff (this publication) is as follows:

		Estimated mean hunting kill 1974–82	Multipl. factor*	Corrected hunting kill
Nfld. 1 (Island)		7461	4	29 844
Nfld. 2 (Labrador)		2645	4	10 580
PEI		56	1.5	84
NS 1 (E & S Shores)	8200	8289	1.5	12 300
2 (Fundy)	89		1.5	134
NB 1 (Fundy)	448	485	1.5	672
2 (gulf)	37		1.5	56
Que. 1 (estuary)		1551	1.5	2 327
2 (gulf)		5234	1.5	7 851

*Wendt and Silieff (this publication) recommended correction factors of 2–4 for Newfoundland and 1–2 for other provinces. We have taken the average value for the other provinces but believe that a factor of 4 is required for Newfoundland.

Season of Newfoundland–Labrador kill
The Newfoundland–Labrador kill extends beyond the end of January (date used in population model), therefore a breakdown is required. From Wendt and Silieff's (this publication) Table 2 the Newfoundland sea-duck harvest occurs as follows (mean 1977–79):

	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
	8710	14 850	15 049	19 245	18 492	19 360	14 268	109 974
% of total	7.9	13.5	13.7	17.5	16.8	17.6	13.0	100.0
	69.4%					30.6%		

Applied to Newfoundland–Labrador corrected harvest of 29 844 + 10 580
= 40 424
× 0.694 = 28 054 (to end of Jan.)
× 0.306 = 12 370 (after end of Jan.)

Summary by harvest region
Kill in Newfoundland–Labrador to end Jan. = 28 054
after Jan. = 12 370
Kill in gulf = Que. 2 (7851) + NB2 (56) + PEI (84) = 7 991*
Kill in estuary = Que. 1 = 2 327*
Kill in Atlantic = NS 1 + 2 (12 300 + 134) + NB 1 (672) + US (16 940: mean 1971–80: Carney *et al*. 1983) = 30 046*

*Almost all prior to 31 January.

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